NEWNES'
PICTORIAL KNOWLEDGE

VOLUME EIGHT

Specially painted for this work by Ellis Silas

A CLIPPER ON THE HOMEWARD RUN

Most famous as well as most graceful of all sailing-ships were the Clippers, a special type of sharp-bowed vessel built for quick sailing and chiefly employed in the China tea trade. The days of their great races to be first home with the season's new tea were between 1850 and 1870, and the record for the run between Hong Kong and London was just under 80 days. With the opening of the Suez Canal the era of the Clippers passed away.

NEWNES'
PICTORIAL KNOWLEDGE

VOLUME 8

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RECORDS OF THE ROYAL NAVY

THERE had been one or two kings before Alfred who made use of ships to help them in their battles. But it is to King Alfred that the main credit must be given as the founder of the Royal Navy. Danish vessels at that time were in the habit of ravaging the coasts of England and were able to land their men at will Alfred determined to put a stop to this form of amusement.

His biggest naval battle off the Devonshire coast was fought with nine of the new ships he had built specially for the task. It must have been a tough fight, with stranded vessels being attacked by parties of men who waded from their own ships to board the enemy craft, or with one ship getting alongside another and beginning a fight which was literally "to the death." Three of the Danish ships managed to get away but, owing to lack of men after the fierce battle, two of them were wrecked and the sole survivor was captured.

This was in 892, and for the rest of his reign Alfred had no more trouble with the Danes. These ships of Alfred's Navy were big for their time. They carried a single mast and some of them had as many as sixty oars. It was a long time before the Danes ventured across the sea again and they had learned the lesson of a big Navy. Having established themselves in England in 1013 they kept a strong fleet in readiness to guard the shores.

Harold, who came to the throne in 1066, might have commanded a fair-sized fleet but was busily occupied in fighting the invaders from Norway and failed to use his ships when the Normans crossed the Channel. Harold lost his life and William the Conqueror made full use of the ships both for defence and trade. William's successors followed the same way and Henry de Burgh in 1217 won a great naval victory over the French off Dover. When Richard Cœur de Lion set off on the Crusades he took the first English Navy overseas expedition, some of his ships carrying forty knights and their horses, with forty foot soldiers and a number of servants as well as fifteen seamen. The stores aboard were sufficient to last them for twelve months.

The men themselves were armed with bows and arrows, pikes, lances and

swords, and had cumbersome weapons for throwing heavy stones, but most of the fighting that took place was of necessity hand-to-hand conflict Yet the Navy was not, strictly speaking, the Royal Navy, nor were the vessels warships. They could trade or they could fight, but they were mostly private ships called on to serve the king. The Cinque Ports were required to furnish a certain number of galleys when demanded and the king paid for their use. It was not always easy to muster the ships and the ports often did their utmost to avoid the service, while the seamen preferred to carry on their own private wars against their neighbours on the other side of the Channel.

The first time the word "admiral" was used was about 1297 when William de Leybourne was made "Admiral of the Sea of the King of England." In 1340 Edward III was able to collect a fleet of some 200 vessels in all to attack a French fleet preparing to settle finally Edward's claim to be King of France. Edward's fleet crossed the sea and attacked the French at their anchorage. The result was the almost complete destruction of the French fleet. Ten years later the Navy of Edward III fought another great battle off Winchelsea against a Spanish freebooter, Carlos de la Cerda, whose forty large ships had captured many English merchant ships. The English won a complete victory and for a short time the freedom of the seas was theirs.

Specially drawn for this work

HOW THE NAVY BEGAN

King Alfred is regarded as the real founder of the Royal Navy and the ships he built were big for their time Our picture shows a ship of the type that protected England's shores in Alfred's reign and kept the Danes away for a full century after his death.

Guns were first used around 1338 and in the time of Henry VII "the King's ships" came into being One of them, the *Regent*, had four masts and was armed with 225 small guns known as serpentines. These ships of the *Regent* class were built for both war and trade; the

Specially drawn for this work

THE CRUSADERS SET SAIL

Our first Overseas Naval Expedition sailed from English ports when Richard Cœur de Lion set forth on the Crusades to help in recapturing the Holy Land from the Saracens for the Christian countries of Europe. The ships carried sufficient stores aboard to last them for twelve months.

holds carried wool from England and brought back wine and other products of sunnier lands. A great part of the world's sea trade then was between the Mediterranean and the Baltic.

Sailors of Queen Bess

The Cinque Ports silted up and Portsmouth and Plymouth grew in importance. There were dockyards at Portsmouth, Woolwich and Deptford. Henry VIII. succeeded his father and inherited the wealth gained by trade over the seas. One of the ships Henry VIII. had built was *Henry Grace à Dieu*, or the *Great Harry*, a vessel of 1,000 tons, carrying over 150 brass or iron guns and 100 smaller guns. It was a show-piece, however, rather badly designed, but all told Henry had a navy of seventy-one ships, and there were many privateers, seeking fortunes but available for the king when necessary. Henry also brought in foreigners to help in the making of cannon, demi-cannon and culverins with which to arm his ships.

Spain had discovered the New World while Portugal opened up the sea routes to the East. Pope Alexander VI. allotted the Western World to Spain and the Eastern to Portugal. England was left out, but her sailors had already begun to explore other parts of the Western world where the Spaniards had not encroached. There was tough John Hawkins, merchant, sailor, Member of Parliament, shipbuilder, and later a rear-admiral, in command of one of his own ships, the *Victory*, when

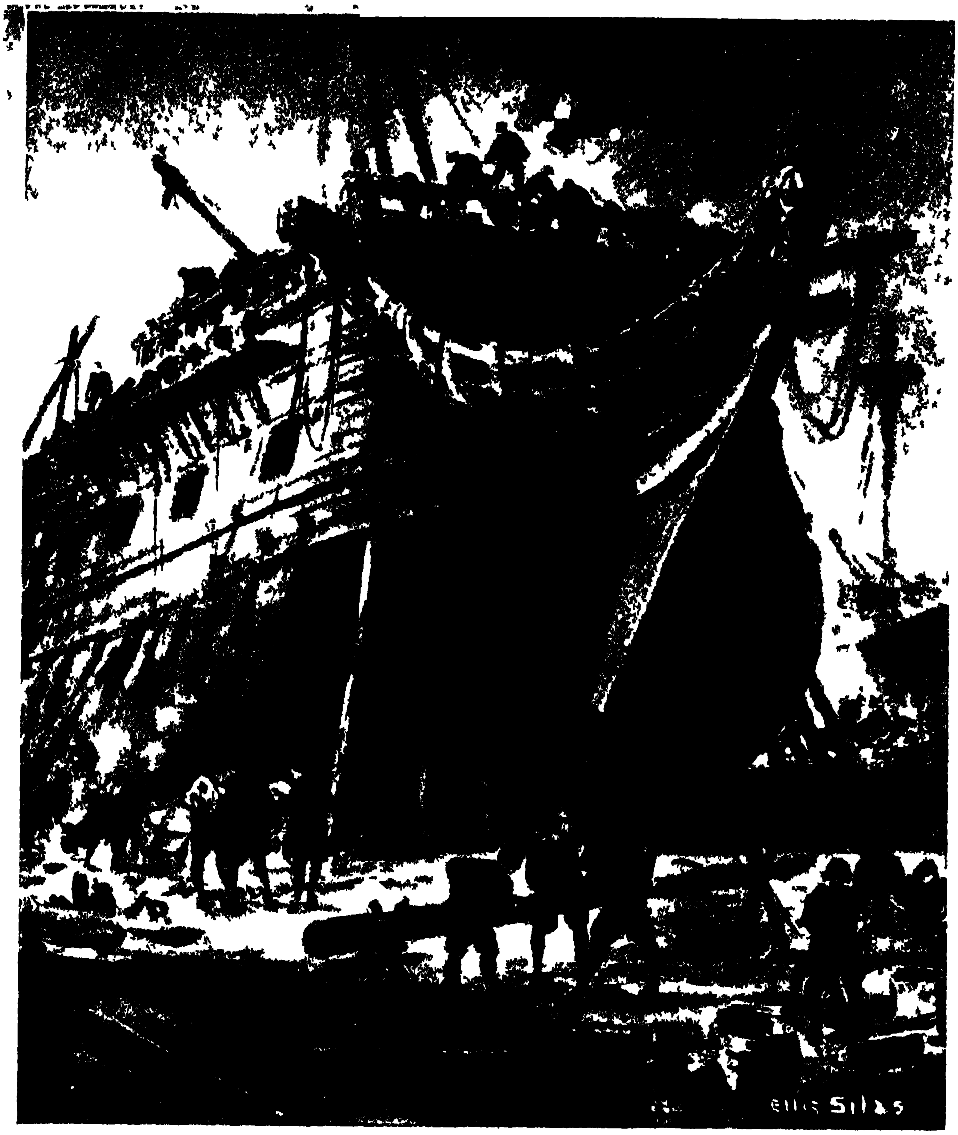
the Armada came. Twice Hawkins sailed to the West Indies without encountering much trouble, but on the third occasion the Spaniards lured him almost to his doom. His ship was sunk, but he managed to board another, the *Minion*, and in the company of the *Judith*, commanded by a young Devon captain, Francis Drake, they sailed back to England, hating the Spaniards and with a fierce determination to open up the New World to British ships.

It was the beginning of a long war, unofficial but deadly in its intensity. Hawkins and Drake harried the Spanish merchantmen and captured immense treasure. Spain protested to England with whom she was at peace. British mariners who fell into Spanish hands were branded and burnt, and British ships were denied the right to sail the Western seas. Drake himself left a message with the envoys of Spain, asserting the right of Englishmen to sail wherever their merchandise was desired. Queen Elizabeth sent Drake on an expedition to find out what preparations the Spaniards were making. Right into the harbour at Cadiz, Drake sailed with four ships and burnt or sank about a hundred Spanish vessels. He had "singed the King of Spain's beard," in his own words, and then

Specially drawn for this work.

FOR WAR OR PEACEFUL TRADING

Henry VII developed overseas trade and built ships of the *Regent* class, as depicted above, suitable for both war and trade. These ships carried four masts and were armed with 225 small guns. The holds carried wool from England and brought back wine and other products.



A DOCKYARD IN THE DAYS OF PEPYS

The first dockyard in British naval history was built at Woolwich about the time of Henry VIII for the king's ships. Other dockyards were built at Portsmouth, Deptford, Chatham and Sheerness. The famous diarist Samuel Pepys was Secretary of the Admiralty in the time of Charles II and our picture shows one of the dockyards at that time.

sailed the Spanish coasts, destroying or capturing other vessels.

Spain was preparing her great Armada to settle once and for all this claim of English sailors to the freedom of the seas and to avenge the acts of violence English ships had committed against the merchantmen of Spain. Drake's exploits at Cadiz and other interferences postponed the sailing of the Armada for two or three years, while in the Netherlands a large

Specially drawn for this work.

A SEVENTEENTH CENTURY FIRST-RATE

Towards the end of the seventeenth century the British Navy had become a fine fighting force and warships such as the "first-rate" shown above utterly destroyed the French fleet and all hopes of a successful invasion by the armies of Louis XIV.

Spanish army under the Duke of Parma lay waiting to be transported to England for the great invasion, once the Armada had cleared the seas of English ships. The English commanders too were waiting, planning to break the Spanish fleet before ever it reached the Netherlands.

The English Navy, that is the "Queen's ships," only numbered thirty-four, but these were reinforced by the impressed ships, galleons, pinnaces, barks and galliots, all merchantmen owned and manned by men of the southern ports, and all ready to fight. Altogether Elizabeth's Navy numbered 197, most of them quite small craft, and on July 19th, 1588, the word came that the Spanish ships were in sight. The main English fleet was at Plymouth, under the command of Lord Howard of Effingham, with Drake, Frobisher and Hawkins as his chief officers, and that same night they put to sea.

The battle, or series of battles, lasted from July 21st to July 29th. The great Spanish fleet was badly handled; the smaller English ships were well manœuvred. Almost from the beginning of

the fight the Spanish leaders were paralysed by the English methods of attack. Even so, the English could not get the upper hand. They could cling on to the enemy's heels and harry his ships without really bringing them to action. Then, as the wind freshened, the Spanish fleet came to anchor off Calais. Howard hastily prepared fire-ships and sent them drifting with wind and tide among the Spanish ships. In panic the Spaniards cut their cables and tried to sail away, and again the English ships attacked, but still had to keep out of range of the Spanish guns, though they drove them to the North, away from the waiting army in the Netherlands. Most of the English ships were short of ammunition by this time and put back to harbour for supplies.

The Spanish fleet was battered and beaten but was not destroyed entirely; it was the storm that completed the work that the English guns and fire-ships had begun. As the remnants of the Armada sought escape round the north of Scotland and down the coast of Ireland, one after another was driven on to the rocks before the fury of the gale and the wrecks of the great Armada were piled up on the coasts of Scotland and Ireland. "The Lord blew and they were scattered" was the inscription in Latin on the medal struck to commemorate the complete overthrow of Spain's mighty Armada.

The untrained army of Elizabeth gathered at Tilbury that summer in 1588 to fight against the invaders from across the water was not unlike another citizen army that was enrolled as a Home Guard 352 years later in readiness for another expected

Specially drawn for this work

OVER A CENTURY AGO

It was not until 1857 that a regular uniform for men of the Royal Navy became official, though the captains for years past had arranged for their men to buy "slop-clothes," as they were called, through pursers. Our picture shows a sailor in the dress generally worn about 1845.

invasion that failed to arrive just as the Duke of Parma's army had failed. The Navy of Queen Elizabeth established the freedom of the seas and broke the arrogant claims of Spain to restrain other ships from sailing wheresoever they wished.

Yet for a time after Elizabeth had died the Navy was allowed to decline. Cromwell revived it and organised a new merchant navy as well as a fighting navy. Under the command of one of the outstanding admirals in English history, Robert Blake, Britain waged war against the Dutch and again established her right to trade on the seas by final victory off the Thames in 1653. Nor did the Navy suffer again when Charles II. was restored to the throne his father had lost. The Navy was directed by a board composed of men of experience such as Sir George Carteret, Sir Robert Slingsby, and others, with the famous diarist, Samuel Pepys, as secretary of the Admiralty

Great Names in Naval History

In the reign of James II. the Navy possessed 173 vessels, and when James gave way to William of Orange and his Queen, Mary, this fleet was ready to defend the shores of Britain against another invasion. It was the French under Louis XIV. who prepared a great army for this purpose. The French fleet was powerful and at the chosen time it was ordered to attack and clear the Channel of all British ships. In May, 1692, two battles were fought, one at Barfleur and the other at La Hogue. The outcome was the utter destruction of the French fleet and once again the waiting armies across the Channel never had the chance to make history on English soil.

For a time the British Navy was supreme and the country's trade spread to the far corners of the world. Then for some years in the eighteenth century the Navy became weak till Anson rose to a position of authority. The story of this great admiral's voyage round the world (1740–44) is told elsewhere in these volumes; his ships became a school for seamen and his officers were men such as Hawke, Boscawen, Rodney, Howe and Keppel, names still honoured in the Royal Navy of to-day. The building of warships was improved, too, though conditions for men at sea were primitive and the food often revolting even to the tough men who could stand up to the hardships inseparable from the life of a sailor in those days.

From Cabin-boy to Admiral

It is to Nelson that many improvements aboard the ships of the Royal Navy were due. "These things are for the Commander-in-Chief to look to," he wrote in 1803 when explaining some of the steps he had taken on his own ships. He believed in the virtues of onions for seamen, good mutton for the sick, and plenty of fresh water for all on board. Lime-juice became a regular issue in Nelson's day. Yet the sailors of the Royal Navy had no official uniform at that time, though efforts were made in that direction by the supply of "slop-clothes" to be bought by the men from the pursers. Actually it was not until 1857 that a regular uniform for men of the Royal Navy became official.

Naval officers had official uniform a century before this. They began their training early. Drake went to sea at twelve and so did Nelson, Rodney, and many other famous sailors. The "cabin-boy" or captain's servant, as he was sometimes called, was generally a youngster known to the captain and taken to sea under his care to learn seamanship. Nelson was a "captain's servant" on his uncle's ship. The rule for many years was that a seven-years' apprenticeship had to be served before a boy became a midshipman. Often enough, however, the captains had the power to promote their protégés in a shorter time. A system of examinations had begun as long ago as 1728

and a Naval Academy was opened in that year at Portsmouth. The cabin-boy method, however, went on until 1859, when the *Britannia* became the training-school of all naval cadets

There was nothing in the way of training or inducements for the men who manned the ships From 1355 in Edward III 's reign down to 1815 the press-gang was the authorised method of recruiting men when ships were short-handed The 'takers,' as they were called in Elizabeth's days, were bodies of men who "impressed" or seized men in seafaring towns and forcibly took them aboard a warship to become sailors whether they liked it or not There were certain rules governing the press-gang but they amounted to very little Even merchant seamen returning from a long voyage overseas were taken and had no redress Some of the local authorities had to supply men under a quota system, and usually did it by releasing prisoners from the gaol so that they would fall into the hands of the press-gang

Specially drawn for this work

THE PRESS-GANG AT WORK

From 1315 right down to 1815 the Navy gained new recruits when volunteers were lacking by means of the press gang Men were forcibly seized in towns by the sea and taken aboard a warship to become sailors whether they liked it or not

It was neither an efficient nor a reliable system and the wonder is that the country tolerated it so long Captains had grounds for complaint too, since men were brought aboard who were totally unfitted for life at sea It is equally remarkable that these pressed men despite the injustice and hardship, made the British Navy mistress of the seas In 1815 the press gang method of recruiting for the Navy came to an end, though the right of impressing men was never properly abolished

There were many other grievances in the Navy which lasted far too long Brutal treatment, wretched living conditions, bad food and little enough of it

at that, and lack of pay were the chief. No wonder there were desertions and mutinies. If was not merely the ships' officers who were to blame; in a good many cases conditions were not so very much better for them on half-rotten ships and poor quarters. Much of the fault lay with those on land whose duty it was to see that the Navy was properly provisioned and that corruption and jobbery on the part of officers and their clerks was made impossible.

Yet reforms did come, and men such as Anson, Nelson, Howe, and John Jervis, when as Earl St. Vincent he became first Lord of the Admiralty in 1801, are outstanding names in naval history not only for their seamanship and battle records but also for the great work they did in improving conditions in the Navy.

The Glorious First of June

When the Seven Years War broke out in 1756 the press-gang as well as the offer of bounties were both needed badly. The Navy was not prepared. Yet by 1759 the French fleet had been beaten in several minor battles and then at Quiberon Bay in the same year Hawke gained a decisive victory. The British fleet was free to go wherever it wished and the outcome of the war was no longer in doubt.

War came again with France in 1793, the beginning of that struggle which developed into the Napoleonic wars. One of the greatest victories in the history of the Royal Navy was the battle which came to an end on the "glorious first of June," 1794, when after four days' fighting the fleet under Lord Howe completely defeated and almost destroyed the French fleet off Ushant. It was followed by other victories off Cape St. Vincent in 1797 and the destruction of the Dutch fleet in the same year. The great plans for the invasion of Britain had once more been temporarily banished.

Yet twice during this year of 1797 there were serious mutinies in the Navy. The first was at Spithead and was well-organised and disciplined; the sailors put many of their officers ashore and refused to sail until their grievances were put right. The Admiralty gave in; pay was raised, some hundred or so officers were dismissed for brutality and jobbery, and the mutineers were pardoned.

The mutiny at the Nore did not end so happily. The ringleader, Parker, was eventually handed over to the authorities and hanged, and the outbreak was sternly suppressed. Yet it was one of several warnings to those in authority and efforts were made to improve conditions in the Navy.

A bigger threat against England was looming up across the Channel. Napoleon Bonaparte's great schemes of domination began to take shape, not only in Europe but towards the East as well. The British Navy under Nelson called a halt to his Eastern plans by the decisive defeat of the French at the Battle of the Nile in 1798. In 1802 came a peace that was merely a temporary truce, and the Navy was kept prepared for the war which threatened almost before the peace treaty was signed.

'Twas in Trafalgar's Bay

It came in 1803 and in the following year Spain joined France. Their combined fleets eventually put to sea in January, 1805, on Napoleon's orders. For two years he had made extensive plans for the invasion of England and the preparations were almost complete. But it was not until October that Nelson was able to bring them to battle. On the 21st of that month the most famous sea battle in English history took place off Cape Trafalgar on the south-west coast of Spain. It was a short but fierce fight. Not until noon was the first shot fired, but by 1.30 the battle was at its height and it was shortly before this that Nelson was fatally wounded on board his flagship the *Victory*. At half-past four

AT THE BATTLE OF THE NILE

Specially drawn for this work.

One of Nelson's great victories was at the Nile on August 1st, 1798. The French admiral's ship blew up, and to save as many of the enemy as possible Nelson ordered the boats away and every exertion was made. As a result about seventy French sailors were saved.

that afternoon the great admiral died with the knowledge that overwhelming victory had crowned his last and greatest battle.

Fifteen enemy ships were taken or destroyed, and of the eighteen that escaped two were wrecked and four others captured later. No British ships were lost. Trafalgar established the supremacy of the British Navy on the seas of the world, a supremacy that was never really challenged for more than a hundred years. In that time great changes took place. The wooden sailing ships of Trafalgar made their last voyages; steam took the place of sails, and iron and steel replaced the wooden walls. Guns were improved and the old solid cannon balls, the grape-shot and chain-shot were ousted by the new explosive shells. Whitehead invented the torpedo in 1870.

Another menace to the big ships came in the last ten years of the nineteenth century. The submarine vessel was not altogether a new idea, but until the motor-engine was devised it was not a very practical proposition to build an underwater craft. Submarines armed with torpedoes were launched and according to some experts their development spelt the death knell of big battleships. Britain was one of the last countries to become really interested in this kind of ship but, having made a start about 1900, she quickly made up the leeway.

The Submarine in War

Then war came again in 1914. The German submarines, known as U-boats, only came into action step by step, though the first attack on a merchantman was made in October, 1914, when the *Glitra*, a steamer of under 1,000 tons, was sunk off Norway after her crew had been given time to get away in boats. Until the Germans proclaimed their disregard for all the rules previously made about attacks on merchantmen, it was laid down by international law that while a warship could capture a merchantman, and, in certain circumstances, sink it, full provision must be made for the safety of all on board, who were of course non-combatants.

In 1915 the Germans proclaimed that the waters round Great Britain and Ireland were a war zone and any merchantmen in those waters would be sunk. Within a year some 1,724 ships of over 1,000 tons were lost. Then early in 1917 an unrestricted submarine campaign was launched and sinkings rapidly increased. The British and American navies concentrated all their ingenuity on efforts to defeat this form of warfare. Convoys, guarded by escorts from the Navy, lessened the sinkings; Q-boats, which looked like harmless merchantmen but were really fully-armed fighting ships, lured the submarines to their doom. Other anti-submarine devices were devised and the U-boat warfare, if not completely mastered, was rendered ineffective.

At the Battle of Jutland

There were no spectacular sea-battles comparable with the Armada, Quiberon, the Nile or Trafalgar, but the battle of Jutland saw a larger number of warships opposed to each other than ever known before. It began on May 31st, 1916, and continued into the next day. Mist, and the excellent use of smoke-screens by the enemy, brought about an indecisive result. The Germans indeed made a weak claim that the victory was theirs since the British losses in ships were rather heavier than the German. On the British side victory could be claimed on stronger grounds. The Germans had tried to avoid action; the British had taken risks to force the enemy to fight and they were left in undisputed possession of the sea with the German fleet forced into hiding, from which it never dared emerge again until the day when it sailed out to surrender at the end of the war.

Most of the German ships were

scuttled by their own crews after that surrender at Scapa Flow in June, 1919. Once the war was over even the victorious nations desired nothing better than a rest from all the strenuous shipbuilding programmes they had laid down. At the Washington Conference in 1921 the leading nations agreed to limit their navies and enjoy a kind of naval holiday for ten years. It was not altogether a success but it gave time to think about the whole question of what naval warfare might mean in the future.

Aircraft for the Navy

Aeroplanes had developed rapidly though their possibilities in naval co-operation had not been tested to any extent. Their development in naval warfare might render the big battleships useless. Ideas and opinions differed very widely, particularly on the question of aircraft carriers. The flying-off deck of such a vessel would be an admirable target for enemy bombers, and once that was damaged the usefulness of the carrier had gone. Nevertheless aircraft carriers seemed necessary. Warships were fitted with catapults to launch aeroplanes, and the Fleet Air Arm experimented with many ideas and with several different types of aircraft.

Then came the war of 1939-45 and the value of aeroplanes to the Navy was quickly demonstrated. Some hard lessons were learned, too, particularly when the Japanese launched their attacks by carrier-borne aircraft on the American Navy at Pearl Harbour in December, 1941.

This sensational start crippled the American fleet for the time being. Two U.S. battleships were sunk, three disabled, three heavily damaged, while

Specially drawn for this work.

THE FIRST BRITISH IRONCLAD

There was long argument before the first British ironclad warship was built, but in 1860 the *Warrior* was completed at Blackwall, and the long and glorious reign of the wooden fighting-ship was over. In time wrought-iron gave way to specially hardened steel plates.

extensive damage or destruction of cruisers, destroyers and aircraft occurred. Three days later the British battleship *Prince of Wales* and the cruiser *Repulse* sailed into the Gulf of Siam without the protection of fighter aircraft and were ignominiously sunk by Japanese bombers For a short time Japan held naval supremacy.

The entry of America into the war extended the scope of naval operations and it was followed by a steep rise in submarine sinkings of our merchant ships as the U-boats pressed into new and undefended waters such as the Gulf of Mexico and the Caribbean Sea.

It was for a time a bad patch for the Allies, especially in the East, where for various reasons it had been impossible for Britain to have her fleet at full strength. There had been other more urgent demands on the Navy in the Western hemisphere. When war broke out in 1939 the powerful French fleet shared with Britain the task of guarding the sea-routes of the world In the Mediterranean the British fleet had bases at Gibraltar, Alexandria and Malta and was also able to use French bases when necessary. Italy was neutral and the Mediterranean was completely under Allied control

In June, 1940, Italy declared war, France fell, and within a short time the coastline of Europe from Norway to the South of France was largely in German hands. The French Navy was no longer with Britain and there was a possibility that it would be used against us The narrow seas of the Mediterranean could now be largely controlled by the enemy aircraft bases in Sicily, Sardinia, and the Italian mainland, while the Italian fleet from its base at Taranto was presumably ready to deal with the comparatively small British Mediterranean fleet. An

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THE FLAG OF SUCCESS

Life on board a submarine in war time may be a grim affair on occasion, but the crew have their proud moments, too Our picture shows one of the submarines of the Royal Navy wearing the Jolly Roger that records her successes as she comes safely home.

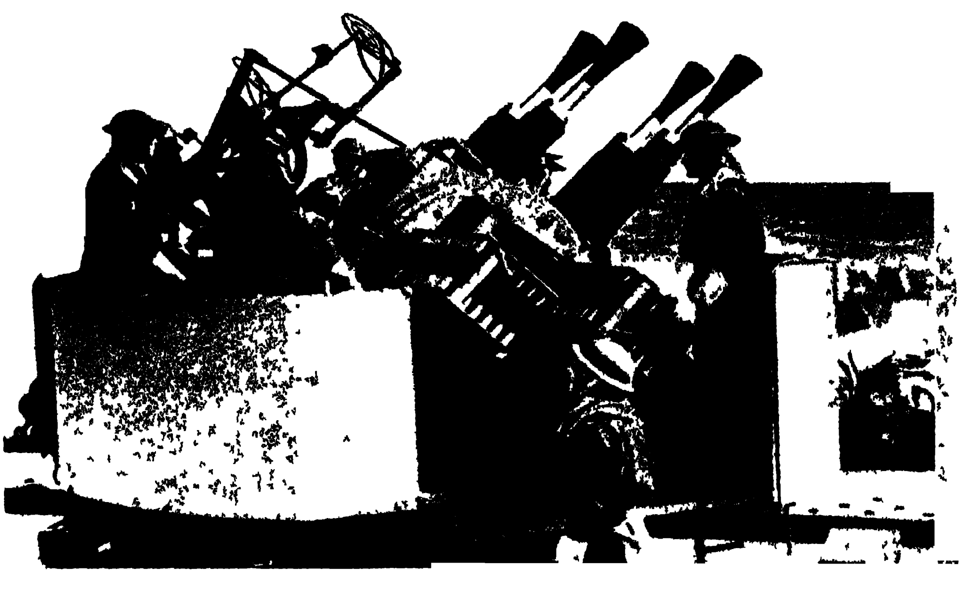
THE COST OF KEEPING THE SEAS

Specially drawn for this work

By air and submarine attack the enemy did his utmost to prevent the convoys bringing supplies to Britain from reaching our ports. Ships of the Navy protected the convoys, and in the picture above an incident of this ceaseless battle is shown: an H class destroyer has received a mortal wound and the end is near.

MOTOR GUNBOATS AND "JOLLIES"

Manned by the young men of the Coastal Forces the Motor Torpedo Boats and Motor Gunboats ' flyweight terrors of the Navy carried out hard hitting raids on enemy shipping during the war years They operated mainly on the east and south coasts from bases seventy five to 100 miles from enemy shores

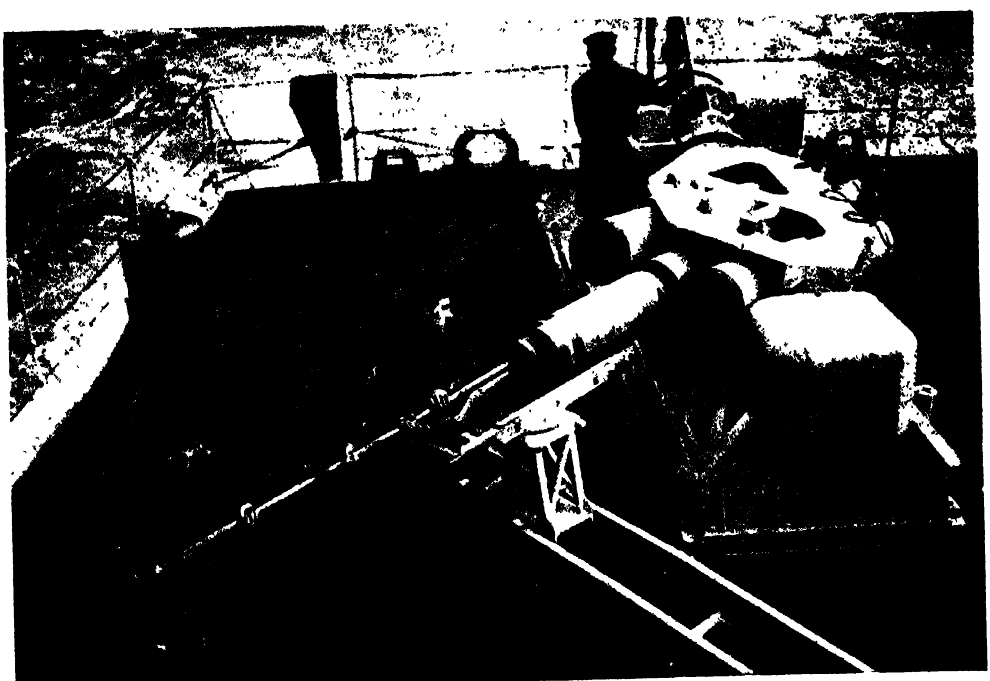


Soldiers and sailors, too, are the Royal Marines, a regiment whose history goes back to 1664, when the Admiralty of that day decided to train their own soldiers for service on board ship Our photograph shows a Royal Marine crew manning the pom-pom gun of a battleship at sea Their nickname of the " Jollies " is almost as old as the regiment itself.

BRITAIN'S LATEST DESTROYER

Topical Press.

One of the largest destroyers ever ordered by the Royal Navy, H.M.S. *Daring*, was the first of her class to be built and after completion joined the Mediterranean Fleet. She is fitted with electrical cooking apparatus and many mechanical and labour-saving devices for cleaning ship. Her displacement is 3,500 tons and her armament includes twelve guns.



Keystone.

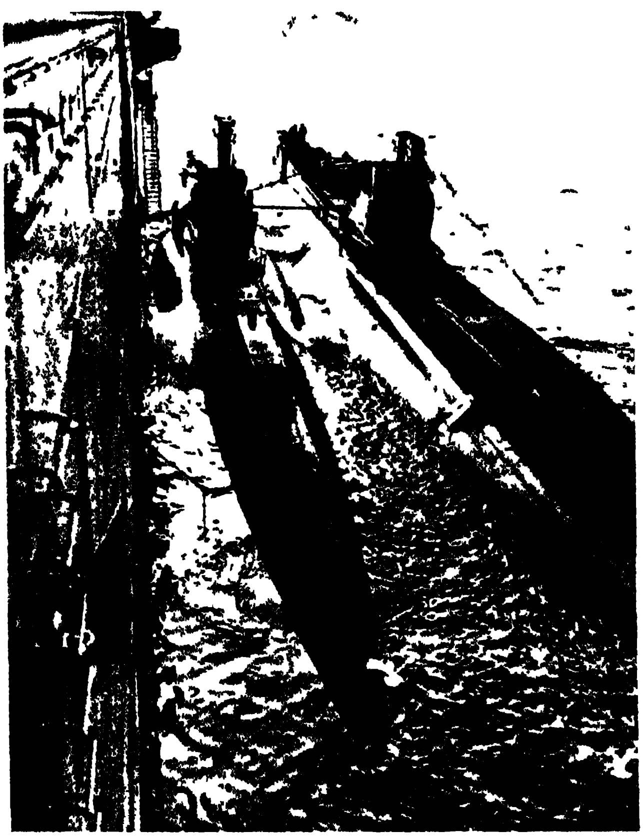
H.M.S. *Daring* was nicknamed " Ugly Ducking " because of her odd appearance, but she is fitted with the most modern radar and other devices. This photograph shows naval ratings aboard the *Daring* loading a " squid," an anti-submarine weapon. This is a type of mortar now carried by many destroyers and frigates. The " squid " fires a pattern of charges ahead of the ship

Italian picture put out just after they declared war showed the British fleet cornered and helpless against the overwhelming Italian sea and air power.

Yet the British Mediterranean fleet under Admiral Cunningham put to sea on the day after the Italian declaration of war and swept the Central Mediterranean. Another force under Admiral Somerville assembled at Gibraltar to defend the Western end and to make attacks in the Atlantic if necessary. The French fleet at Oran on the North African coast suddenly became a dangerous threat and Admiral Somerville was compelled to sink or damage some of the French ships. At Alexandria the French ships agreed to disarm.

In the Mediterranean

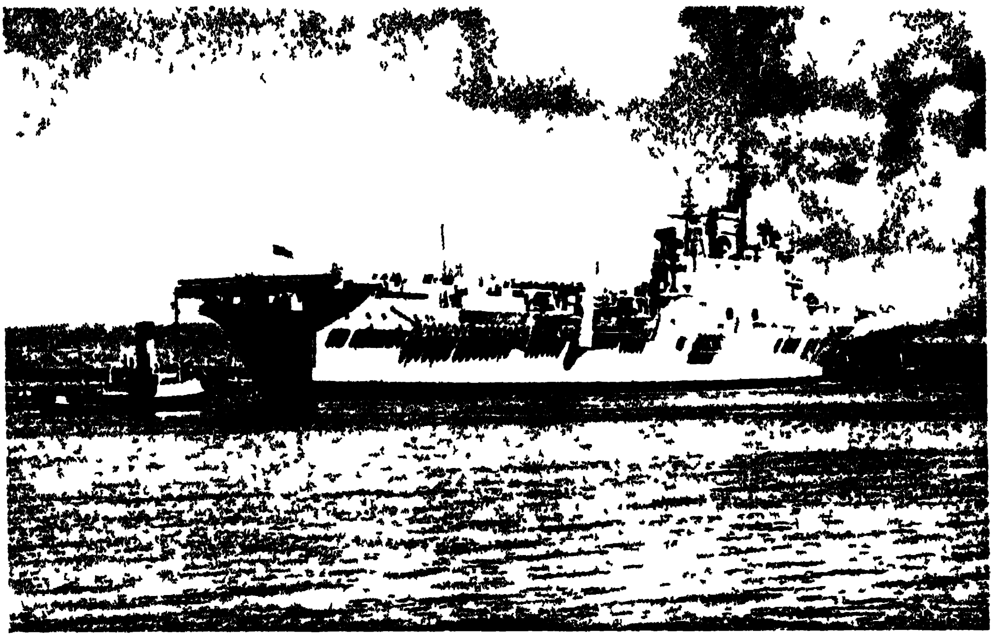
When the Italian fleet did at last venture out they were promptly attacked, and just as promptly they turned away and raced back to port again. In July there was another clash and an Italian cruiser was sunk; the Swordfish of the Fleet Air Arm were also busy whenever opportunity offered and sank submarines, destroyers and depot-ships. Our own submarines were also engaged on many hazardous tasks, while destroyers carried out surprise night bombardments until the Australian officer in charge of the flotilla had to report "All targets driven inland, leaving practically nothing to be engaged from seaward."



A SUBMARINE DEPOT SHIP

At certain naval bases submarine depot ships are established. They contain a workshop and stores of all kinds to replenish the submarine home from patrol, while the crews themselves can take advantage of sun-ray equipment and recreation rooms.

The Italian fleet refused to be drawn from its safe hiding-place in the harbour at Taranto. The aircraft carrier *Illustrious* took up a position 170 miles from Taranto on November 11th, 1940, and from there her torpedo-carrying planes attacked the Italian ships. Half the Italian fleet was put out of action that night and the oil-storage depot was successfully bombed by the flare-carrying planes after they had lighted the target for the torpedo-carrying planes. Photographs taken by reconnaissance aircraft the next day confirmed the airmen's belief that tremendous damage had been done. The



Central Press

BRITAIN'S LARGEST AIRCRAFT CARRIER

Britain's largest and newest aircraft carrier H.M.S. *Eagle*, 36,800 tons, is seen here. Built by Harland & Wolff at their Belfast yards, she was the first in any Navy designed to operate jet aircraft and is able to launch one every twenty seconds from her flight decks which cover more than two acres. H.M.S. *Eagle* is the twenty-first British warship of her name.

night's work made the British Fleet the master for the time being of the Mediterranean.

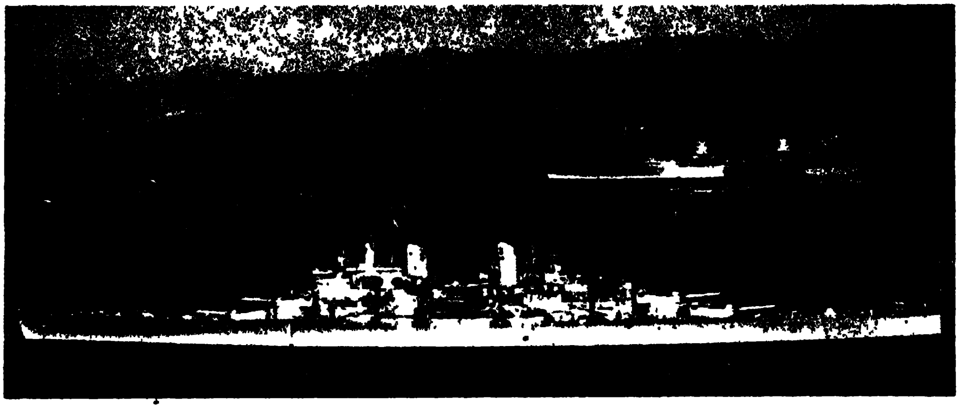
Greece had entered the war when Italy invaded the country in October 1940. Fresh responsibilities were laid upon Admiral Cunningham's fleet. Troops had to be safely transported from North Africa to help the Greeks in their desperate struggle. The Italians were beaten back, but the German Luftwaffe appeared on the scene. Against them the British had little or no fighter opposition to put up.

The Spirit of Tenacity

Towards the end of March, 1941, the Italian fleet decided to come out. Overwhelming odds on land and in the air had driven the British army in Greece into desperate straits. The Italians were in a position now to upset any plans the British fleet might have in connection with evacuating the Army from Greece and Crete. The result was the brilliant night victory off Matapan when the British fleet sank at least three 10,000-ton cruisers and two destroyers, and crippled the flagship of the Italian fleet as well as seriously damaging other enemy ships. The rest of the Italian fleet made no further attempts to interfere with the work of the Navy but left it to the Luftwaffe. With little to oppose them the German planes made the position of the British forces on Crete a hopeless one.

Aircraft and gliders brought over the German land forces. The attempts of the Germans to take troops across from the mainland by sea were frustrated by the British Navy. On one night alone, that of May 21st, 1941, an enemy convoy carrying 4,000 German soldiers to Crete was completely destroyed.

The Germans did their utmost to exact a full revenge by air attacks on the fleet, and the damage they did was heavy. Nevertheless, despite the heavy strain both men and ships sustained,



Planet News, Ltd

MIGHTIEST BATTLESHIP AND LARGEST LINER

In this photograph is seen Britain's mightiest battleship, the 42,500 ton H.M.S. *Vanguard* as she sails down the Clyde and passes quite near to the biggest ship in the world, the 85,000 ton liner *Queen Elizabeth.*

the task was accomplished; the Army was safely brought back from Greece and Crete though the German hordes took possession of the land. At the end of his dispatch the Commander-in-Chief wrote "There is rightly little credit or glory to be expected in these operations of retreat, but I feel that the spirit of tenacity shown by those who took part should not go unrecorded."

Romance and Drudgery

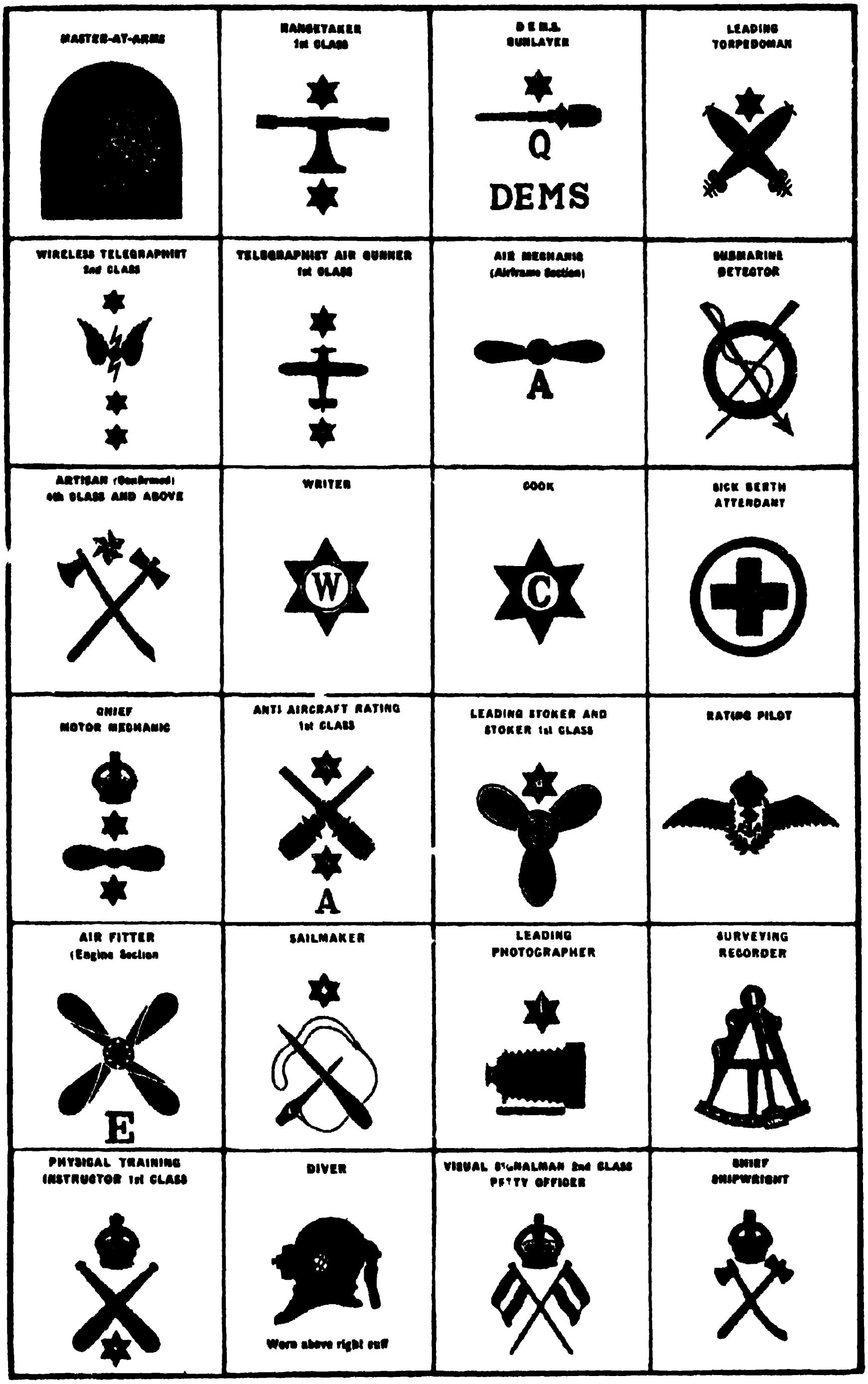
That same spirit of tenacity was shown by the Royal Navy on all the Seven Seas. Whether guarding the convoys across the Atlantic, to Malta, to North Africa, through the Arctic to take much needed supplies to Russia, across the equator to India and Burma or still farther, to the Pacific where the Japanese fleet was for just a short time triumphantly dominant, or whatever other task they were called upon to do, the Navy carried it through.

To-day the Royal Navy is made up of many types of ships from mighty battleships to midget submarines. There are great aircraft-carriers, battle-cruisers, destroyers, corvettes, frigates, scout and patrol vessels, mine-layers and minesweepers, fast-moving motor gunboats and motor torpedo-boats

Each type made its own special contribution to naval supremacy, and most of them would require volumes to themselves to give their story adequately. Stories of the submarines and the aircraft-carriers make thrilling reading, but there are other craft that scarcely seem to offer much in the way of romance but a great deal of hard drudgery with even a bigger share of dangerous risks.

There are the minesweepers, for instance, many of them in peace-time doing their job as fishing trawlers. In war-time they changed over from fishing for herrings to the more dangerous task of fishing for the deadliest ship-wrecking devices German scientists could devise. They kept the channels to our ports clear of the dreaded mines. With mine-laying submarines and aeroplanes the enemy hoped to make every port in Britain impossible to enter or leave. Mine-sweeping demands courage of the highest order as well as precise navigation. The work was often done in the face of air attack and with quite a big possibility that

SOME BADGES WORN BY NAVAL RATINGS



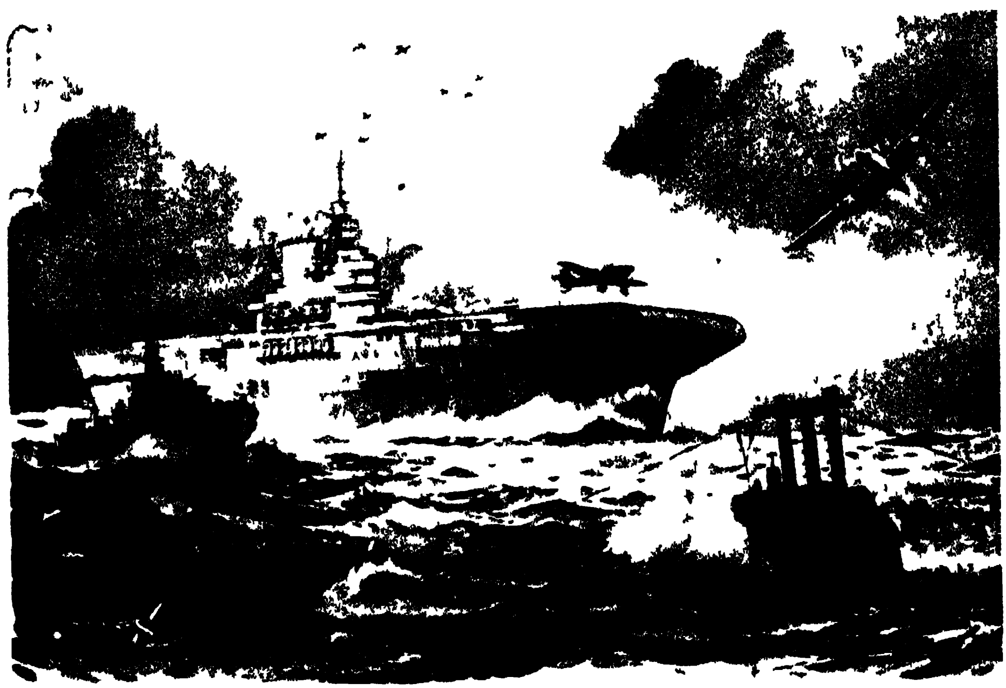
the vessel would itself be mined. Many minesweepers were lost, but the work went on unceasingly.

One of the Secret Weapons

There was one particular type of mine, however, that beat even the minesweepers for a time and threatened to accomplish the enemy's highest hopes. This was the magnetic mine, the first of Hitler's secret weapons, though the idea was not entirely new by any means. The ordinary moored mine, constructed with sufficient buoyancy to float just below the surface of the sea, exploded only if one of the sensitive horns was broken by the impact of the hull of a ship. The magnetic mine lay on the bottom in comparatively shallow water. Its firing mechanism was actuated by the magnetic field of a ship passing above it.

The recovery intact of the first magnetic mine for the naval scientists to examine is one of the greatest stories of British seamen's gallantry during the war. Once the scientists had it in their hands the remedy was soon found. Magnetic minesweepers were produced and, in addition, all merchant ships were fitted as soon as possible with a de-gaussing girdle which neutralised the ship's magnetic field and left the mine over which it passed as harmless as a chunk of old iron at the bottom of the sea.

The acoustic mine was another secret weapon. Its existence was suspected and an unexploded mine recovered, rendered harmless, then dissected and examined by the naval scientists. In this case the firing mechanism was operated by the sound waves transmitted through the water from the

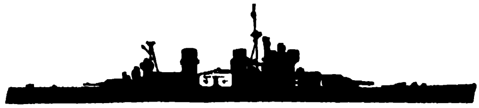


Radio Times

AT SEA WITH THE FLEET

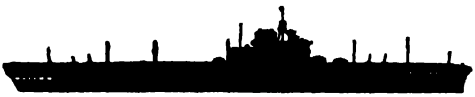
Exercises under conditions such as those which would be encountered in wartime are regularly carried out by ships of the Royal Navy. In this drawing by C. E. Turner an impression of such an exercise while it was taking place in the Channel is depicted. The aircraft carrier H.M.S. *Illustrious* is escorted by a destroyer and an enemy submarine can be seen on the right, while both defending and attacking aircraft are coming into action.

SILHOUETTES OF SOME BRITISH WARSHIPS



Battleship of the King George V class 35,000 tons length 745 feet horsepower 125,000 and speed of 30 knots Crew 1,500

Battleship of the Nelson class 33,900 tons length 710 feet horsepower 45,000 and speed of 23 knots Crew 1,360



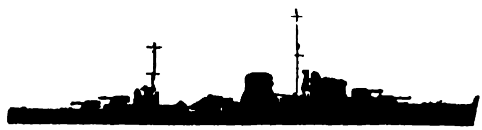
Aircraft carrier of the Indomitable class 23,000 tons length 700 feet horsepower 140,000 and speed of 32 knots Crew 1,600

Escort carrier of the Tracker class converted merchantman length about 495 feet Crew about 550

Cruiser of the County class 10,000 tons length [illegible] feet horsepower 80,000 and speed of 32 knots Crew 650

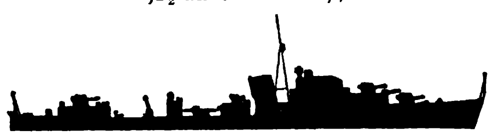
Cruiser of the Fiji class 8,000 tons length 549 feet, horsepower 72,500 with speed of 33 knots Crew 700

Cruiser of the D class 4,850 tons length 472 feet horsepower 40,000 with speed of 29 knots Crew 400

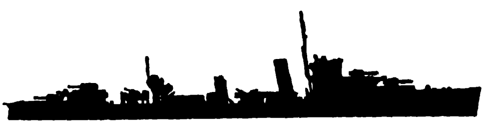


Cruiser of the Leander class 7,200 tons length 554 feet, horsepower 72,000 and speed of 32½ knots Crew 550

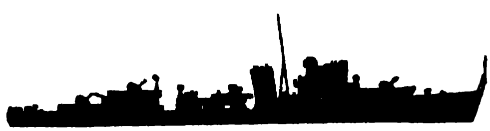
Destroyer of the Tribal class 1,870 tons length 356 feet horsepower 44,000 and speed of 36½ knots Crew 190



Destroyer of the J class 1,690 tons length 348 feet horsepower 40,000 and speed of 36 knots Crew 183

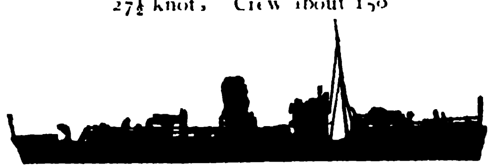


Destroyer of the V and W class 1,100 tons length 312 feet horsepower 30,000 and speed of 31 knots Crew 134



Destroyer of the Hunt class 904 tons length 273 feet horsepower 19,000 and speed of 27½ knots Crew about 150

Sloop of the Black Swan class, 1,250 tons, length 280 feet, horsepower 3,600 and speed of 19¼ knots Crew about 190



Corvette of the Flower class 925 tons, length 193 feet Quadruple expansion engine gives speed of 17 knots. Crew 85

ship's engines The answer was found, and remained a secret, but the acoustic mine joined the magnetic mine as a weapon which failed to explode

The Battle of Scientists

In naval warfare it is to-day as much a battle of wits between scientists on each side as it is between the skill and courage of the men on board the ships on either side At Trafalgar one of the French ships opened fire on the *Victory* at 1¼ miles range, to which Nelson's ship made no reply until within 30 feet, and then every gun on the broadside came into action

At the Battle of Midway Island in June, 1942, when the American Navy inflicted heavy damage on the Japanese fleet, the battle opened when the opposing fleets were 700 miles apart All the casualties, including four aircraft-carriers lost by the Japanese and one by the United States Navy, were caused by naval aircraft flying many hundreds of miles from their carriers during a four-day battle

Conditions of naval warfare have undergone remarkable changes within the last few years, and difficult problems will face those in charge of our Navy during the next few years The new weapons, and in particular the range, speed, and capacity of modern aircraft, have brought in tremendous new factors Even the biggest and most heavily armoured battleship can be sunk by aircraft. The only protection is adequate fighter cover to drive off the attacking planes That means more aircraft-carriers and perhaps fewer mighty battleships Naval Aviation to-day is probably the most essential branch of the Navy

The Navy Will Be There

Whatever new types of warship may be evolved, or whatever new trades or professions may be added to the long list already practised by our modern sailors, one fact stands firm The Navy will be there, as it always has been, and the great traditions built up through long years by British seamen will be carried on Old Tom Bowling has gone below and the great sails have given place to turbine engines, electricians and mechanics, wireless and radar operators, engineers and photographers, all form part of the big ship's company to-day, but the skilled sailmaker has not vanished, though his job to-day is to repair the canvas of gun coverings and awnings

Drake is in his hammock, sleeping his last long sleep in Nombre Dios Bay, but his spirit is still alive in the Royal Navy of to-day That spirit has been shown a thousand times since the days when the sailors of Britain established their right to the freedom of the seas and drove the invader from our shores "It is upon the Navy, under the good Providence of God, that the wealth, safety and strength of the Kingdom do chiefly depend"

The Ships that Carry British Merchandise Across the Seas—

And the Men who Bring Back the Food To Our Home Ports

THE MERCHANT NAVY

FOR long centuries Britain has been a seafaring nation, and the Royal Navy dates its beginning to the closing years of the ninth century when King Alfred built his long-boats to ward off invasion No one can be so definite about the beginning of the Merchant Navy, from little boats that ventured on perilous voyages between one coastal settlement and another, and carried on some form of barter, the Merchant Service slowly developed To-day the carrying of merchandise and passengers in ships sailing to and from all parts of the world has become one of Britain's greatest industries.

The first shipping code was drawn up in the reign of Richard I (Cœur de Lion) who reigned from 1189 to 1199 Richard needed many ships to transport his fighting men to the East on his great Crusade The Crusades, indeed, began an era of travel in Western Europe and opened up the possibilities of trade by means of shipping In Magna Carta (1215) it states in the 41st Article that " all merchants shall have safe conduct to go out or come into England and to stay there, to pass either by land or water and to buy and sell by the ancient allowed customs without any civil tolls "

Trade with the Continent began to grow, and the history of the Navy is mixed up with that of the merchants' ships, which were liable to be called upon to serve the king in defence of the realm at any time Edward III (1322–77) was the first English ruler who directed his policy towards the expansion of trade He fought wars against France in order to make the English merchants' trade with Flanders more secure

It was in this reign, too, that the Merchant Adventurers came into prominence They were a body of leading merchants chiefly concerned with the export of cloth to the Continent where their great trading centre was Bruges Similar companies were formed later in Bristol and York Not very much is known about the ships which were used for this Continental trade in the fourteenth and fifteenth centuries, but it is probable they were under 100 feet long and by modern standards no more than 200 tons burden They carried one sail and were fitted with a rudder hung on the stern-post Before this period

vessels were steered with a rudder lashed to the starboard quarter

Bigger ships were built and the Portuguese began to take a lead in shipbuilding, though the shipbuilders in Venice and Genoa were also well known In England naval architecture developed during the reign of Henry V, but the merchant service suffered for it The Portuguese, on the other hand, designed ships to withstand the gales of the Atlantic and it was her navigators who began that great era of exploration when the vast continent of North and South America was discovered, the coasts of Africa were explored, and both the East and West Indies became known

A great deal is owed to a Portuguese prince, Henry the Navigator, son of an English mother and a grandson of John of Gaunt Maritime exploration and scientific navigation were the objects to which he devoted the greater part of his life To a very considerable extent it was these studies of Prince Henry and the improved instruments for navigation he devised, as well as his methods of charting, that made longer voyages possible

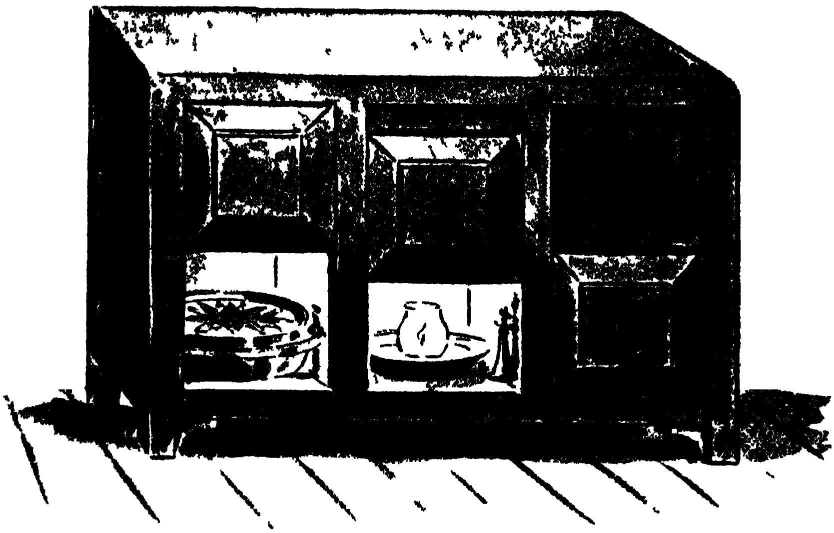
The compass had been known long before his time and was steadily improved The astrolabe enabled the sailor to calculate latitude and to take altitudes It was superseded in the eighteenth century by the quadrant and then by the sextant For a long time the hour-glass was the only means of telling time, while the actual speed of the vessel was largely a matter of guesswork

Christopher Columbus in his *Santa Maria* was the first to touch the fringes of America when he landed on the Bahamas, but John Cabot, born in Genoa as Columbus was, is entitled to

Specially drawn for this work

A SHIP OF THE 15th CENTURY

In the earlier years of shipbuilding in this country a vessel was designed for both trade and war The ship depicted above was known as a carrack and with its bluff bows is typical of the 15th century Usually these vessels were about 600 tons burden



Specially drawn for this work

A BINNACLE OF THE 17th CENTURY

In the ships of the 17th and 18th centuries the half minute glass compass long board etc were stored in the binnacle or bittacle as it was then spelt and in the picture above is shown one of these old time essentials for navigation

claim to be the first to have set foot on the mainland Cabot made his home in Bristol, and in 1496 received from Henry VII an authority to "seek out discover and find" all hitherto unknown lands Bristol already had a considerable trade with Iceland and Cabot decided to explore Greenland After that he turned south and eventually touched the coast of Canada in the region of Quebec The inhabitants had only fish, furs and timber to offer To-day these are valuable enough, but they were not the kind of merchandise Cabot had set out to find and he returned with little to show for his venture

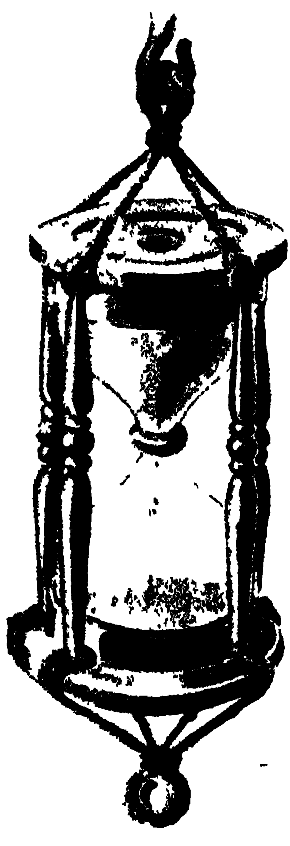
Gradually the Spaniards and the Portuguese established important trade routes to America and India, and, with the backing of the Pope, they claimed exclusive rights to all the vast wealth opened up to them by these early navigators Magellan, who renounced his Portuguese nationality owing to a quarrel with the king, offered his services to Spain He was the first to cross the Pacific, and though he himself was killed in a fray with the natives of the Philippine Islands in April, 1521, his ship, the *Vittoria*, under its captain, Sebastian del Cano, reached Seville in September, 1522, after a three years' voyage They had sailed more than 40,000 miles and circumnavigated the world

Francis Drake was the next to sail round the world in 1577–80 He was followed in 1586–88 by Thomas Cavendish who brought back much valuable information This led a few years later to the founding of the famous East India Company and British trade with the East was opened up

There were other navigators who brought back knowledge and valuable information. Merchants anxious for trade and fortune took big risks A

ship was bought and a captain and crew were gathered. The merchant probably staked his whole fortune in the ship and cargo she carried. The sailors staked their lives, yet volunteers were never lacking. There was the prospect of adventure and of a fair reward, even the gambling chance of picking up something of very considerable value on one's own account, since much of the trade in these early days was by barter.

The East India Company, otherwise "the company of the merchants of London trading to the East Indies," received its charter from Queen Elizabeth on December 31st, 1600. It was largely concerned with the establishment of trading stations or factories in India. Although it was purely a trading concern it was highly necessary to arm many of its ships and the East Indiamen became the most famous sailing-ships of the seventeenth and eighteenth centuries. A rival company was sanctioned later, but the two were amalgamated in 1701 and became the Honourable East India Company.



Specially drawn for this work

THE SAILOR'S SAND-GLASS

The old navigators kept time by the sand-glass, or sea clock, which indicated the half hour. Eight times in his four hour watch the man at the wheel turned the glass and marked the time by striking upon a small bell near him.

The East Indiamen usually sailed in convoy and were ready to give battle to any of the foreign privateers lying in wait for such rich prizes. If an East Indiaman fell a prize on rare occasion to some French privateer, it can also be said that more often than not it was the privateer that had the worst of the battle. In due course the East India Company built their own East India Dock in 1804 to enable larger vessels to be docked nearer the heart of the City.

Life on board an East Indiaman was in many ways better for both crew and passengers than in any other ships sailing the seas at that time. But it was very poor compared with the accommodation aboard ships after sails had given way to steam. A cabin passenger on an East Indiaman had to bring many of his own supplies, such as bedding, wine and servant, but his free luggage was from 1½ to 3½ tons. The food would seem to have been good, though this depended largely on the honesty of those in command. Live cattle and poultry were carried to last the voyage which usually took some seven months.

Speed was not then regarded as anything of great importance as there was no competition between rivals. British ports since Cromwell's day had been open only to British ships. It was not until 1849 that the Cromwell Acts were repealed. Similar conditions obtained in several other countries, including the

U.S.A. after they had their own ships, but all these restrictive laws were eventually abolished almost universally.

Most famous of the sailing-ships were the Clippers, a name applied to a particular type built for speed and to carry a special type of cargo Until about 1850 only those ships engaged in such occupations as privateering (or what really amounted to piracy) or in slave-trading, or smuggling, were much concerned about speed. Then, from one cause or another, the monopolists, such as the East India Company, had to face competition on both the India and China trade routes.

Specially drawn for this work

TAKING HIS SIGHTS

Here we see the master of a ship in the year 1590 using his cross staff to observe the position of the sun The staff has a sliding piece which was moved up and down until the upper end was in line with the sun Columbus, Drake and other great mariners used the cross staff

Tea at this period was a valuable and expensive cargo and the earliest consignments commanded high prices. Large quantities can be stored in a fairly small space and clipper-built schooners were ideal for the China tea trade. The first record-breaker was the American *Oriental*, one of the first vessels to take advantage of the opening of British ports to all ships. She did the voyage from Hong Kong to London in ninety-seven days.

British ship-owners soon took up the challenge and the sailing-ship record still stands to the credit of the *Ariel*. This British ship only ran for seven years, but took part in several Clipper races from China. She made the record of seventy-nine days twenty-one hours for the voyage between London and Hong Kong

The *Ariel* was lost on her first trip to Australia in 1872 through carrying too much sail. A heavy wind plunged her bows under water and she went to the bottom.

As merchant ships the clippers had their faults and life aboard them in rough weather was often desperately hard, but they were splendid in their

beauty, and even the pictures of them bring to mind all the romance and wonder of the sea. It is scarcely surprising that the men who learned their seamanship aboard such ships looked down with a certain amount of contempt on those who sailed aboard ships without sails and never climbed high above deck to set sail on a swaying yard.

Most famous of all British clippers was the *Cutty Sark*, though she was not built till 1870, when the days of the clippers and of most of the merchant sailing-ships were nearing their end. The *Cutty Sark* took part in several races and put up some splendid times, on one occasion covering 363 miles in one day on the China run.

The Suez Canal was opened in 1869, and steamships able to use this route had a tremendous advantage over the sailing-ship. The *Cutty Sark*, the *Thermopylæ*, and other well-known clippers went on the Australian run, bringing home cargoes of wool. Both these vessels were eventually bought by the Portuguese Government. Later the *Cutty Sark* was bought again by an English captain and finally came to rest in Falmouth Harbour as a training-ship.

Steam had been used to propel a vessel as long ago as 1801 when the *Charlotte Dundas* was used as a tug on the Forth-Clyde Canal, but owing to damage caused by the wash from her paddle wheel she was put out of business. In America, the *Clermont*, using engines supplied by Boulton and Watt,

Specially drawn for this work

AN EAST INDIAMAN OF 1700

In the reign of Queen Elizabeth the company which later became known as the Honourable East India Company was founded and its ships became the most famous of their time. They were ready to give battle to privateer or pirate who dared to attack them while life on board was more comfortable for both passengers and crew than in any ships afloat in those days.

Specially drawn for this work

OUT OF THE STORM

Life on the old windjammers especially in rough weather was often desperately hard In the picture above the artist has depicted the plight of a Clipper after rounding the Horn in a hurricane A mass of tangled cordage and splintered spars, the weather-beaten craft steers for the nearest port under such rig as she can manage.

carried passengers on the Hudson River in 1807, but it was not till 1827 that an all-steam crossing of the Atlantic was made by the Dutch steamer *Curacoa* Before this, however, the *Susannah*, which had an auxiliary paddle-wheel, crossed in 1819, taking thirty-five days for the passage, but using her engines on only eighteen of these days.

The first British steamer to do the crossing was the *Sirius* of 703 tons. She left Queenstown and took nineteen days for the trip to New York. This was in April, 1838, and some hours after the *Sirius* had reached port the *Great Western* also arrived in New York, having taken three days less than the *Sirius* to do the crossing.

Another revolutionary idea came to the stage of practical test about this time. Iron, instead of oak, had been tried in shipbuilding, but was strongly opposed, particularly by the Admiralty. When it was found that iron ships did not sink there was still an objection that cannon shots would pierce iron more easily than the stout timbers of a wooden man-o'-war. It took many years to convince the Admiralty that iron had any advantages over wood.

The builders of merchant ships had no such doubts, though it was a long time before iron and steel really displaced wood, just as the sailing-ship did not by any means vanish as soon as the steamer appeared on the sea.

One famous windjammer was the *Herzogin Cecile*, built in 1902, which ran on the rocks off the Devon coast in 1936 when homeward bound from Australia. She was refloated, but broke her back later and so ended her career.

It was in 1843 that the first big trans-atlantic steamer was built at Bristol. This was the *Great Britain*, a vessel of 3,270 tons, measuring 323 feet long, 48 feet broad, and 31½ deep. She was fitted with engines of 1,500 horse-power, and her voyages across the Atlantic were quite successful. Unfortunately she ran ashore off the Irish coast in 1846 and lay there stranded for nearly a year, defying the waves to break her up. Finally she was refloated and sailed the seas again, though she ended her days as a full-rigged sailing-ship.

Famous Names in Shipping

The great names of the big shipping companies begin to appear from 1830 onwards. The P. & O. began as the Peninsular Steam Company about 1835 when Arthur Anderson and Brodie Wilcox bought the *William Fawcett*, a paddle-steamer of 209 tons. Later they obtained a contract for carrying the mail weekly from Falmouth to Gibraltar, calling at Vigo, Oporto, Lisbon and Cadiz. The name was afterwards changed to Peninsular and Oriental Steam Navigation Company, and Anderson lived long enough to see P. & O. ships sailing regularly to India and China, with their own repair depôts at many ports between.

Another great name in shipping history is that of Samuel Cunard, owner of whalers at Halifax, Nova Scotia. He was past fifty when he came to England in 1838 to found a shipping company in partnership with George Burns and David McIver of Liverpool. This was known as the British and North American Royal Mail Steam Packet Co. as they had been successful in obtaining a valuable contract to carry mails. The first Cunard vessel crossed the Atlantic from Liverpool to Boston in 1840, taking fourteen days eight hours for the voyage.

Later the company became the Cunard Line and, since the amalgamation with another company, has been known as the Cunard White Star Line. The White Star Company was formed in 1871 by T. H. Ismay, who had been head of a line of clippers as well as a director of the National Steam Navigation Co. formed in 1863

Donald Currie began his career in the Cunard Line, but left them to found the Castle Line in 1862, not as rivals in any way to the Cunard Line, but to run a service from Liverpool to Calcutta and later to South Africa. In 1900 the Castle Line was amalgamated with the Union Steamship Company to become the Union Castle Line.

There was James MacQueen, a Scottish journalist, whose passion was the sea and travel. He submitted plans to the Government for a steam packet service to carry mails to the West Indies, North America and the Far East. After a good deal of struggle he succeeded in obtaining a contract. For this purpose the Royal Mail Steam Packet Company was founded and received its charter in 1839.

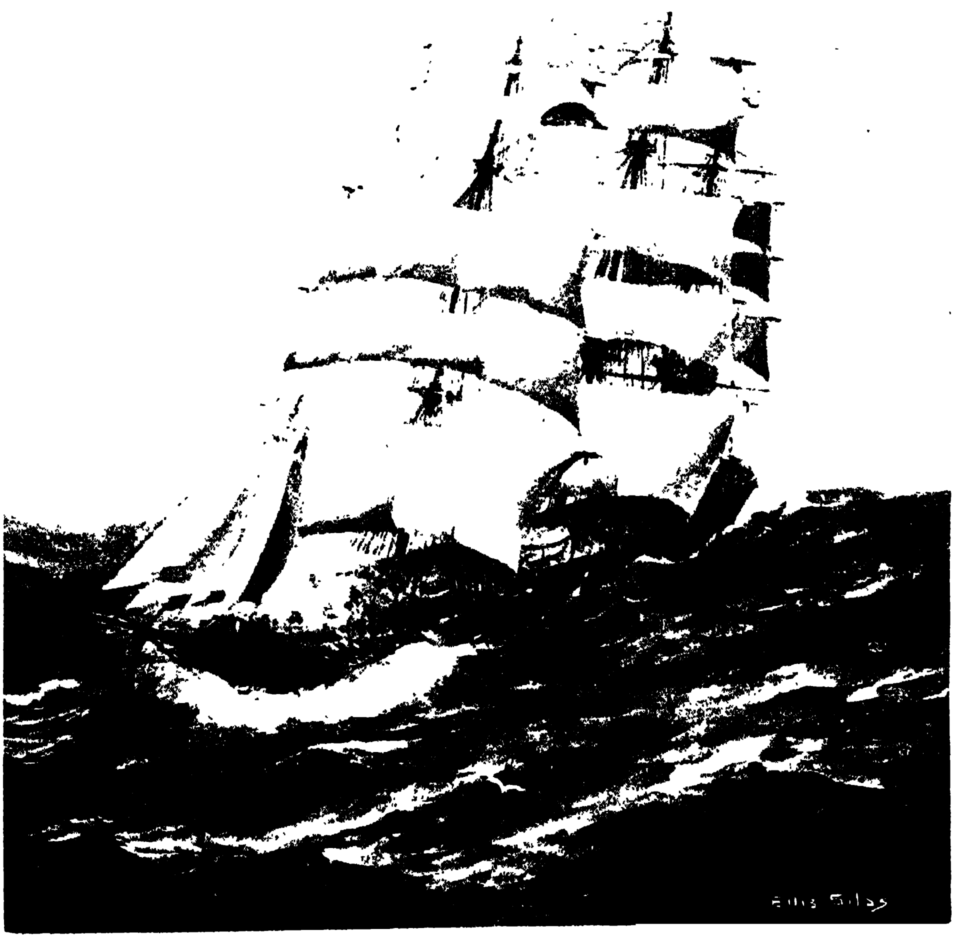
Tramps and Food Ships

It was in this way that most of the great shipping companies were formed. There were other men who made their names and fortunes as shipowners, but in a rather different class. Ocean-going ships can be divided into three kinds: the great passenger lines, of which such a company as the Cunard White Star is an example. These carry a certain amount of cargo besides a large number of passengers. Next, the cargo liners which have fixed runs and a regular schedule showing the ports of call and dates of arrival and departure.

Then there is the tramp ship which has no regular schedule; the tramp is not necessarily a small ship, but whatever her size she is prepared to go to

any part of the world and to pick up a cargo from any port. Broadly, in normal times, the tramp's main cargoes from England are coal while the imports which she brings back are timber, grain or iron ore. Nearly all the tramp shipping companies were formed by men who were seamen or employed in shipping offices. Runciman, Nicholl, Reardon-Smith, and Hain were among shipowners who began life as lads before the mast.

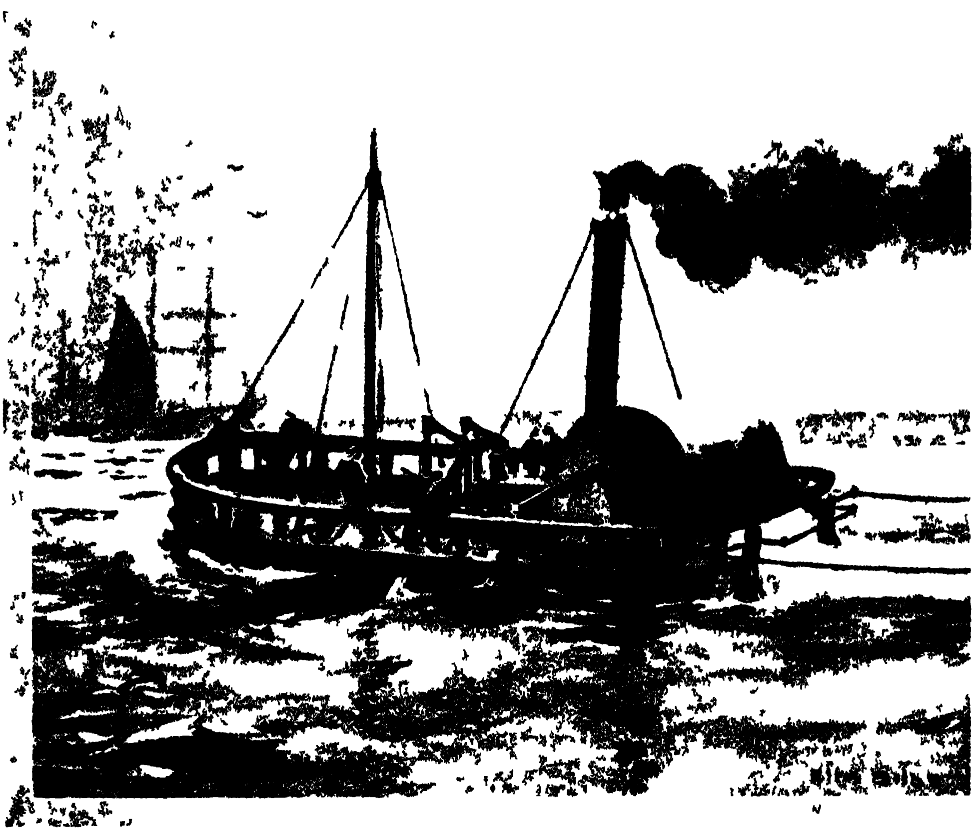
There are the special ships, too, such as the oil-tanker which may carry up to 20,000 tons of oil, and the foodstuff carriers, fitted with elaborate refrigerating devices. Frozen meat has become a highly important cargo now that the greater part of our population is fed on meat brought from Australia, New Zealand or South America. It was in 1880 that the very first cargo of frozen meat was brought to this country from Australia.



Specially drawn for this work.

MOST FAMOUS OF BRITISH CLIPPERS

Although not built till 1870, when the days of the fast sailing-ships engaged on the China run were drawing to a close, the *Cutty Sark* took pride of place among all British Clippers. She took part in several races from Hong Kong to this country and on one occasion covered 363 miles in one day.



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THE FIRST PRACTICAL STEAM BOAT

In 1801 the *Charlotte Dundas*, a steam boat built by William Symington, was used as a tug on the Forth Clyde Canal and towed two heavily loaded barges. Protests were made and eventually the *Charlotte Dundas* had to be taken off the water because of the damage caused by the wash from her paddle wheel.

For some sixty years before the Great War of 1914–18 the British merchant ships did very well, while British seamen were known in every port in the world. During the Great War, however, the enemy did all in his power to prevent our ships bringing their cargoes of food and raw materials to British ports. It was then that the country realised to the full just what the Merchant Navy meant to us in our island home.

In the old days life at sea on board a tramp was pretty grim and there were owners who neglected to spend money on necessary repairs, or insisted on having their ships loaded to a dangerous degree. One man, Samuel Plimsoll, spent the greater part of his life in calling attention to the scandal of what he called "coffin ships."

A Royal Commission was appointed and eventually the Merchant Shipping Act of 1876 was passed. As a result of that Act all our merchant ships are compulsorily marked with a circle, having a horizontal line drawn through it, to indicate the maximum depth to which the vessel can be loaded. The Plimsoll Mark, or Load Line, is a testimony to the efforts of Samuel Plimsoll to secure safer conditions for the merchant service.

There are other precautions taken now to ensure that every British ship is seaworthy. Lloyd's Register classifies each ship, and, even when it is building, the Lloyd's surveyor watches

the progress and sees that everything on board is up to standard requirement Not until he is satisfied is the ship given her letters and figures which form her passport for insurance and chartering A first-class steamer is marked 100 A1 A steamer marked merely A1 is generally one that has been built to the surveyor's satisfaction for some special purpose All vessels must be surveyed every four years *Lloyd's Register of Shipping* gives the list of every ship in every country (except certain Japanese and Chinese sailing vessels) of over 100 tons gross

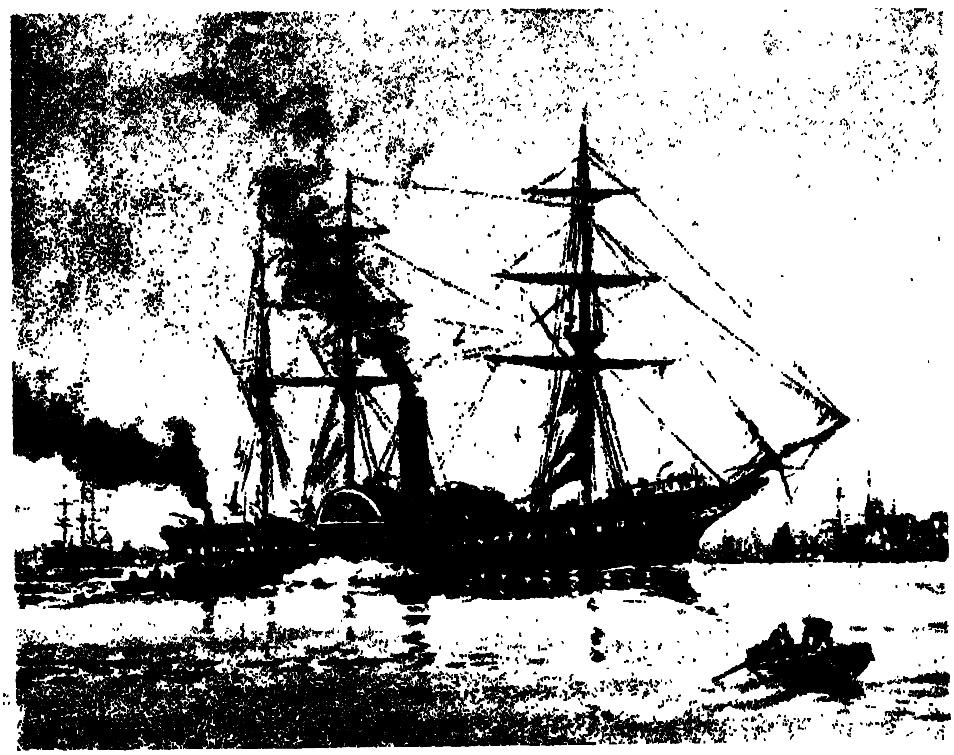
It should be noted that *Lloyd's Register* is a separate institution from Lloyd's, the great corporation of marine underwriters who insure ships and cargoes as well as risks of other kinds The members of Lloyd's, whose home is in Leadenhall Street, London, deal in marine insurance and are governed by a committee elected by themselves *Lloyd's Register*, with headquarters at Fenchurch Street, London, classifies all ships and has surveyors in almost every port in the world, it is controlled by a committee of shipowners and others concerned with the seaworthiness of vessels, and issues regular lists of ships, showing their movements as well as giving other information

After the war of 1914–18 British shipping, which had performed such magnificent services despite all threats from submarines and mines, drifted into the doldrums, to use the term the old sailors employed when a sailing ship lay becalmed and helpless One third of our ships had been lost and those built hastily to replace losses were not up to standard Other countries which had relied on British shipping had been compelled to build their own vessels while British shipping trade for countries other than our own had ceased to exist In 1935 the British

Specially drawn for this work

FIRST BRITISH STEAMER TO CROSS THE ATLANTIC

In April 1838 the *Sirius*, a paddle steamer of 703 tons, did the Atlantic crossing under steam from Queenstown to New York in 18 days. A Dutch steamer made the first crossing 11 years earlier while the *Great Western* reached New York a few hours after the *Sirius*



Specially drawn for this work.

THE FIRST CUNARD LINER

Samuel Cunard founded in 1838 the line that still bears his name and in 1840 the first liner of the new Company, the *Britannia*, accommodating 115 passengers and 200 tons cargo, made her maiden voyage across the Atlantic in 14 days, 8 hours from Liverpool to Boston. She was a paddle-steamer, 207 feet long, with engines developing 740 h.p.

Shipping (Assistance) Act was passed, and a subsidy of £2,000,000 was granted to tramp shipping. With this aid and general reorganisation shipping improved to some extent, but when war came again in 1939 there was a sudden great need for merchant ships and for the men to sail them.

Then, too, when war broke out quite a large number of merchant officers and seamen went immediately into the Royal Navy, either because they were in the Royal Naval Reserve or were serving in vessels which became armed merchant cruisers, such as, for instance, the *Jervis Bay*. Moreover, during the years of peace before 1939 many men had left the Merchant Service. Ships had lain idle, out of work, as were the men who had manned them. In many cases marine engineers found jobs ashore, but deck officers had not the same openings and in some cases took jobs as ordinary hands aboard ship again. Roughly some 15,000 men left the sea each year and replacements were few.

What this meant when war came can be understood if we bear in mind that at normal times at least one-third of Britain's food in weight comes to us from overseas. Most of our meat, butter, cheese and wheat is brought to us in ships, whether British or foreign. In time of war we need all that, but we also need the munitions of war, raw materials, petrol for aircraft on an ever-increasing scale. One bomber raid on

DRAKE DESTROYS THE SPANISH FLEET AT CADIZ

One of the [illegible] exploits of that [illegible] Sir Francis Drake [illegible] the war [illegible] Spain. The Spanish fleet lay at Cadiz almost ready [illegible] attack [illegible] With [illegible] ships Drake sailed [illegible] into the harbour and [illegible] of the enemy vessels. [illegible] the King of Spain [illegible] Spanish [illegible]

[illegible]

MORGAN LEAVES HIS SHIP TO BOARD A PRIZE

Most notorious of all the pirates that sailed the Spanish Main was Captain Henry Morgan. After working as a slave in Jamaica he joined the pirates and rose to command twelve vessels with 700 men under him. His greatest exploit was the sack of the Spanish city of Panama, which was pillaged and burnt. Eventually Morgan was brought for trial to England but was acquitted and later knighted by Charles II who sent him back to Jamaica as Lieutenant-Governor. He fell into disgrace later, and died in obscurity.

Germany with 500 planes took 750,000 gallons of oil All of it comes to Britain by sea

Ships were needed to take men overseas or to bring others to this country Ships and more ships were wanted—and the men to sail them They came The first call was for those who had served on ships since 1936, and by 1941 nearly 60,000 officers and men had registered There were other volunteers, too in the list is a cabin boy of fifteen and a half (they don't take boys under sixteen, but this Scots boy was there), a bos'n of twenty-eight with 100 men under him engineers of sixty,

Specially drawn for this work

A DEEP-SEA FISHING TRAWLER

In peace time the trawler plays a big part in supplying this country with fish in war time the same vessels did valiant work in mine sweeping, as well as in many other hazardous tasks The trawler is larger than the drifter and drags its large nets known as trawls along the bottom of the sea

and a greaser whose age was seventy-five! The second mate of one big ship was a J.P. who had left the sea twenty years before, while an able seaman who came back owned hunters, flew his own plane, and sailed his own yacht. A junior engineer was Maths master at a big school.

Not all the seamen on British ships belonged to these islands. There were more than 45,000 Indians, besides Chinese and Arab firemen. Asiatic sailors are usually known as Lascars or "Indian seamen," and cause much less trouble than some of the Chinese. Stories of Lascar bravery and devotion to duty are certainly not wanting and their services were invaluable in war time.

The Call of the Sea

It is on record, too, that the young seamen of to-day are not behind the older men in anything but experience, and in some ways they begin with a flying start. Education gives them an advantage many of the older men never possessed. The newcomer can set a course by the stars and judge wind direction by cloud formations and weather reports. And the records have many stories of youngsters who took charge of a boatload of survivors after their ship had been sunk, and they proved themselves as coolly efficient as any older man would have done. Moreover, despite the stories of sinkings and the dangers of life at sea in war-time, there were more applications from boys anxious to go to sea than at any previous time in history.

In war-time the ships sail in convoy, fifty or sixty, or even more ships. A Commodore is in charge of them all and his job is to keep the ships together as a fleet, take all necessary steps to ward off attack from submarines or aircraft, to see that no chink of light shows from the ships at night, and to keep up the stragglers, whether they are falling behind, or, as may happen, getting too far ahead of the rest of the convoy. There are many other details on which the Commodore advises the captains at the conference before the convoy sails. Lifejackets must be examined to see that their lights are in good order. Coloured sails for the ships' boats are important as they enable rescuers to see the boats much more easily.

There are scramble nets on the Commodore's ship to prevent wrecked men from drifting helplessly past. Other points are explained on the subject of what must be done if a ship is unlucky and falls a victim to the submarines. "Believe me, you won't be left," the Commodore assures them, and wherever it was humanly possible the helpless men were rescued after their ship had gone down. It was a long and bitter struggle against the U-boats, but the merchant ships never failed to sail, and gradually, as one device after another was brought into operation, the peril of the U-boat packs was overcome to a very considerable extent, though it never ceased to exist till the war ended.

For Courage and Endurance

Aircraft played a great part, too, in rescue work. In one instance aeroplanes flew some 25,000 miles before their search was rewarded and they were able to drop a message to tell the helpless occupants of a solitary ship's boat that rescue was near at hand. Stories of individual heroism on the part of merchant seamen are legion. Even the record of the many awards for courage and endurance in the face of incredible difficulties can only tell of a fraction of the truly great deeds the merchant sailors performed. Men lived on flying-fish or dived overboard to scrape weeds from the bottom of their boat; they collected rain in small tins, and tried every device possible to keep alive till rescue came. One officer kept a log in tiny writing on the back of labels from condensed milk tins.

Ships' boats and rafts were eventually fitted with water-distilling apparatus.

A solid fuel that can be saturated with seawater without harming it is part of the apparatus. All boats and rafts were equipped with buoyant self-igniting electric lights which come into operation when the craft reaches the sea. Early in the war a buoyant waistcoat or lifejacket was devised which could be worn even when at work.

It was a civil servant who devised a clip-on red light which could be switched on or off as necessary. This was fitted to all lifejackets and saved many hundreds of lives. Another civil servant designed the protective suit, weighing only 3 pounds 6 ounces, yet windproof and waterproof, for wear in open boats and rafts. Another idea which came into use was a simple wireless transmitter which sent out an automatic signal from the lifeboat. Few of these were in use when war began, but determined efforts were made in every direction to find means of lessening the risks and hardships following the sinking of a ship.

Perhaps the most famous of all convoys were some of those which made the run to Malta after Italy had joined Germany. Mussolini announced his intention of clearing all British ships from the Mediterranean. It didn't quite work out like that, of course, but German and Italian aircraft, flying from bases in Sicily and Southern Italy had every chance it seemed of preventing any supplies getting through the narrow seas to the little island of Malta. Once supplies were stopped there would be little hope for the island, "the unsinkable aircraft carrier," as it had been called.

Yet the convoys, battered and damaged, with a record of ships sunk, carried out the message sent by Vice-Admiral Somerville to every ship's master in one of the convoys. "Remember, everyone, that the watchword is THE CONVOY MUST GO THROUGH."

The cargoes aboard the ships were vital to the island: fighter aircraft and parts, guns, shells, ammunition;

Central Press

A FAMOUS WINDJAMMER

It was long after the coming of steam before the merchant sailing ships disappeared. Our picture shows the *Herzogin Cecilie* which was built in 1902 and sailed the seas till 1936

thousands of tons of aviation spirit in 4-gallon tins, maize, wheat, flour, corned beef and mutton, cloth, cement, cigarettes and tobacco. There were other necessities without which Malta could not have continued its heroic defence against the continual attacks from the air. As a token of the admiration of Britain for the fortitude and courage of the Maltese people, the island was awarded the George Cross.

Not only aeroplanes, but fast-moving motor gun-boats, the German E-boats, slipped out at night to attack the convoys. They claimed their victims, yet in some way supplies got through. The famous tanker *Ohio*, carrying aviation spirit and petrol in cases and drums, had her full share of enemy fury. On one August convoy she was torpedoed, lamed, and set on fire; the tail of a dive-bomber fell on her decks; her boilers blew up and her engines failed. Yet, taken in tow by two escort ships, she reached Malta, two days late, but with her precious cargo safe.

There were convoys across the Atlantic and through the icy Arctic seas to Russia. Troops and supplies were sent to the desert army in North Africa. Voyages to the Middle East

Specially drawn for this work

HEROES OF THE "SAN DEMETRIO"

Sailing in convoy the oil tanker *San Demetrio* was shelled by an enemy pocket battleship and set on fire. Her crew were forced to abandon the ship but later a few men adrift in a life boat boarded her again, put out the flames, got the engines going and brought the tanker safely across the Atlantic to the Clyde.

THE "JERVIS BAY" SAVES THE CONVOY

[illegible]

On the evening of November 5th, 194 as the convoy sailed into the gathering dusk an enemy warship was sighted. The *Jervis Bay*, a light armed merchantman, went ahead to give battle while the convoy sought cover of darkness. Fighting against overwhelming odds the *Jervis Bay* went down at last but the convoy was safe.

Specially drawn for this work

SAFE HOME IN PORT

The big merchant steamer has come to the end of her long voyage and has been safely docked. In the picture above our artist depicts a scene at the Port of London where the ship has been tied up and is ready to discharge her cargo

had as big a variety of hazards as any other route. Never had such armadas of ships left Britain's shores as those which sailed to North Africa in 1942. In addition to the First Army and its reinforcements, these ships took 394 aircraft, 63,784 vehicles, 900 tanks, 3,677 guns, and six locomotives and tenders. Petrol, oil and coal, and hundreds of thousands of tons of stores and equipment were carried. In addition, 1,416 aircraft were taken to Gibraltar during this period and then the planes were flown onwards to their various landing-grounds.

Then came the great D-Day of June 6th, 1944. The merchant ships had their full share in this tremendous undertaking, and in particular the little ships of coastal waters. Preparations had begun two years before. Cross-channel ships that had taken holiday travellers to the Continent in peace days were making the trip again, but this time they were fitted as infantry assault ships. Coasters which had carried coal and potatoes between Liverpool and Ireland were overhauled and made ready for the great day. There were many hundreds of them and the short sea voyage allowed these little ships to carry men and tanks in great convoys across the Channel, and then go back for the next shipment.

There were deep-sea vessels, too, carrying special landing craft to take the troops on board from ship to shore. Many of them came under heavy fire from the shore batteries and there was bombing from the air by night. But the landings were made, stores and equipment put ashore, repair shops erected and airfields quickly in use. The weather was not particularly kind, and on June 20th tugs had to be sent

post-haste to deal with ships being driven ashore in a full gale that lasted almost without a break for six full days. Only heroic efforts on the part of the crews enabled the unloading to go on as soon as the storm abated.

When Victory Came

"We are seamen and soldiers and dockers, too," one chief officer said, and that was true enough. As the invading forces became firmly established and armies and supplies increased, so did the number of ships grow. The task went on as other ports were opened; always the armies were kept supplied. The Merchant Navy played its very full part in all the hard and often heroic work that eventually brought the day of victory in May, 1945.

Peace brought no relief so far as the merchant ships were concerned except the fact that enemy attacks by aircraft and U-boats were no longer to be feared. That was an important factor, but the tasks of the ships became more urgent than ever. There were millions of men, women and children in Europe who were on the verge of starvation and with no hope of relief except by the food the United Nations could bring them. The burden in the main was bound to fall on Britain, still free, still powerful, still possessing a great Merchant Navy, despite all the efforts of enemy U-boats.

Facing Further Cuts

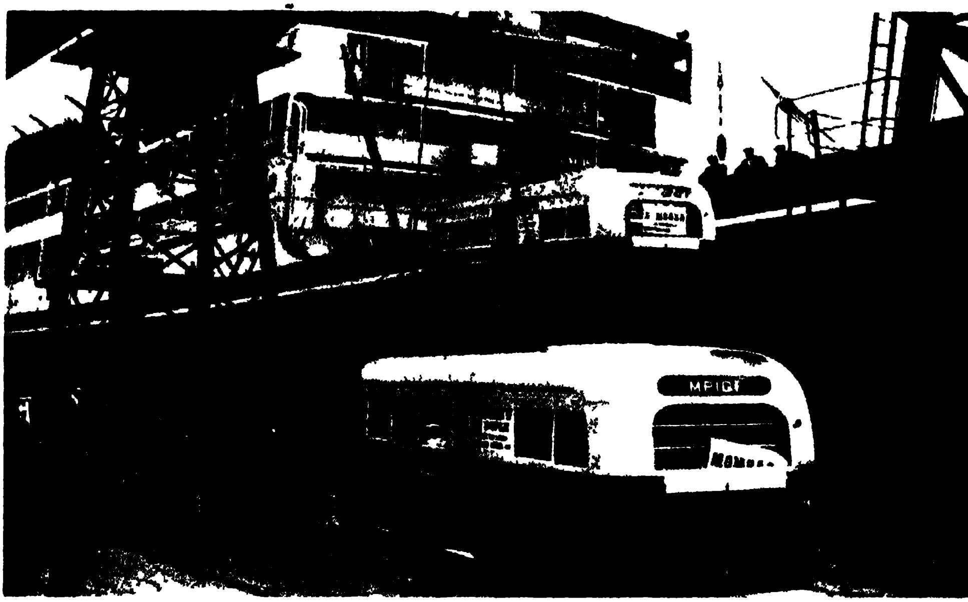
Britain herself had cut down her food rations to the lowest level on which the workers could remain fit and strong. Stocks had gradually been reduced in those months when everything was concentrated on the final supreme effort to win the war at the earliest moment. The people of this country were justified in thinking that the end of the fighting would mean a

Crown Copyright

AN HISTORIC PICTURE OF A MIGHTY CONVOY

One of the greatest convoys that ever left our shores was that which took a great army with all its machines of war to land in North Africa in November, 1942. The Merchant Navy carried this army and the Royal Navy escorted it while British and American Air Forces maintained constant patrol to ward off enemy bomber attacks.

BRITAIN CAN MAKE IT



Fox Photos

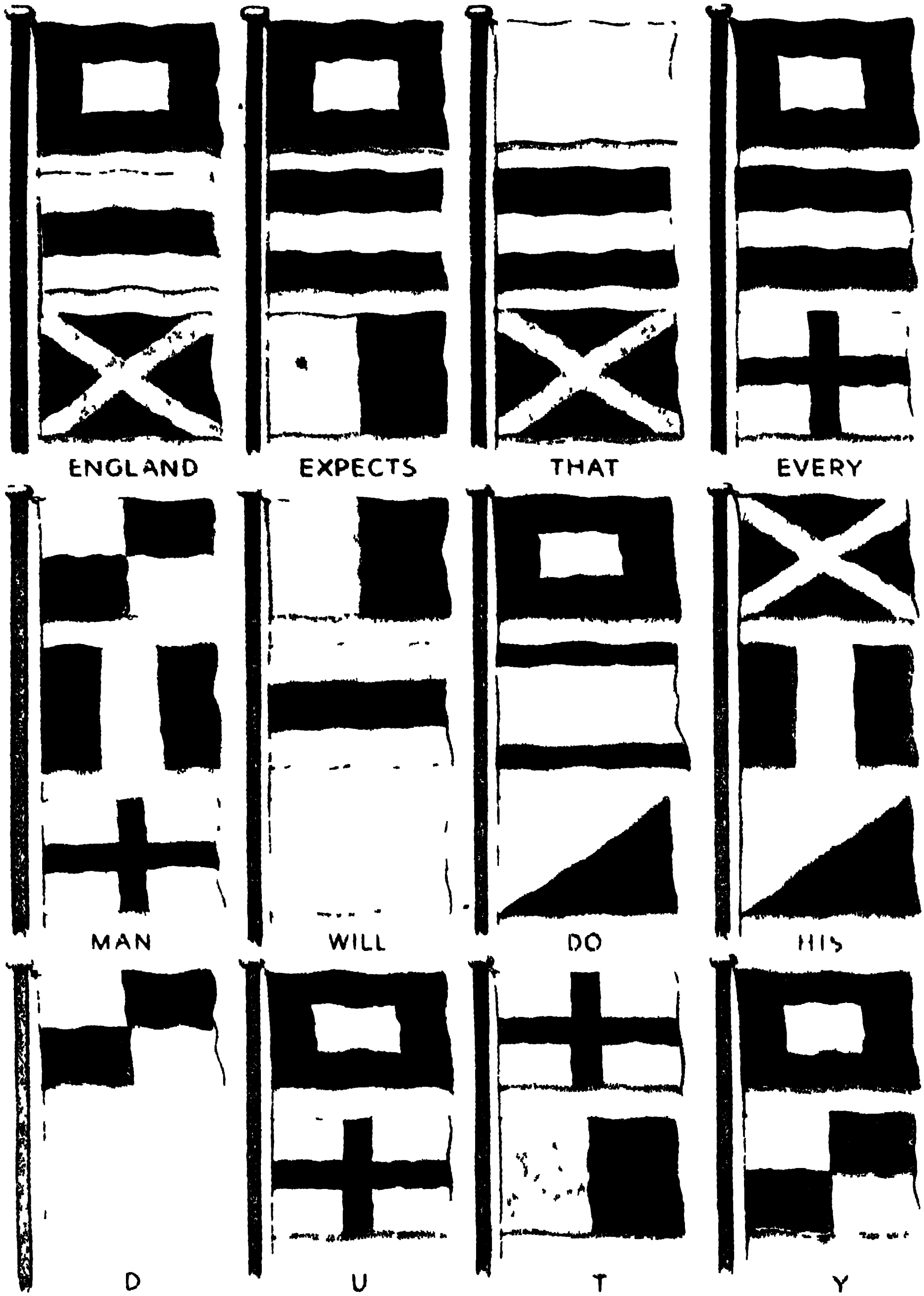
Napoleon once described this country as a nation of shopkeepers and it is upon our capacity to supply the world with the products of British factories that our prosperity depends. In this photograph, we see a fleet of motor buses, made in Britain, being shipped aboard a steamer for an East African port

P. N. Ltd

Big ships require big tackle and some idea of the size and weight of the ropes for the *Queen Mary* can be gathered from the photograph above which shows a huge coil of rope being rolled along the dock-side at Southampton to be taken on board

A NAVAL INCIDENT IN WAR TIME

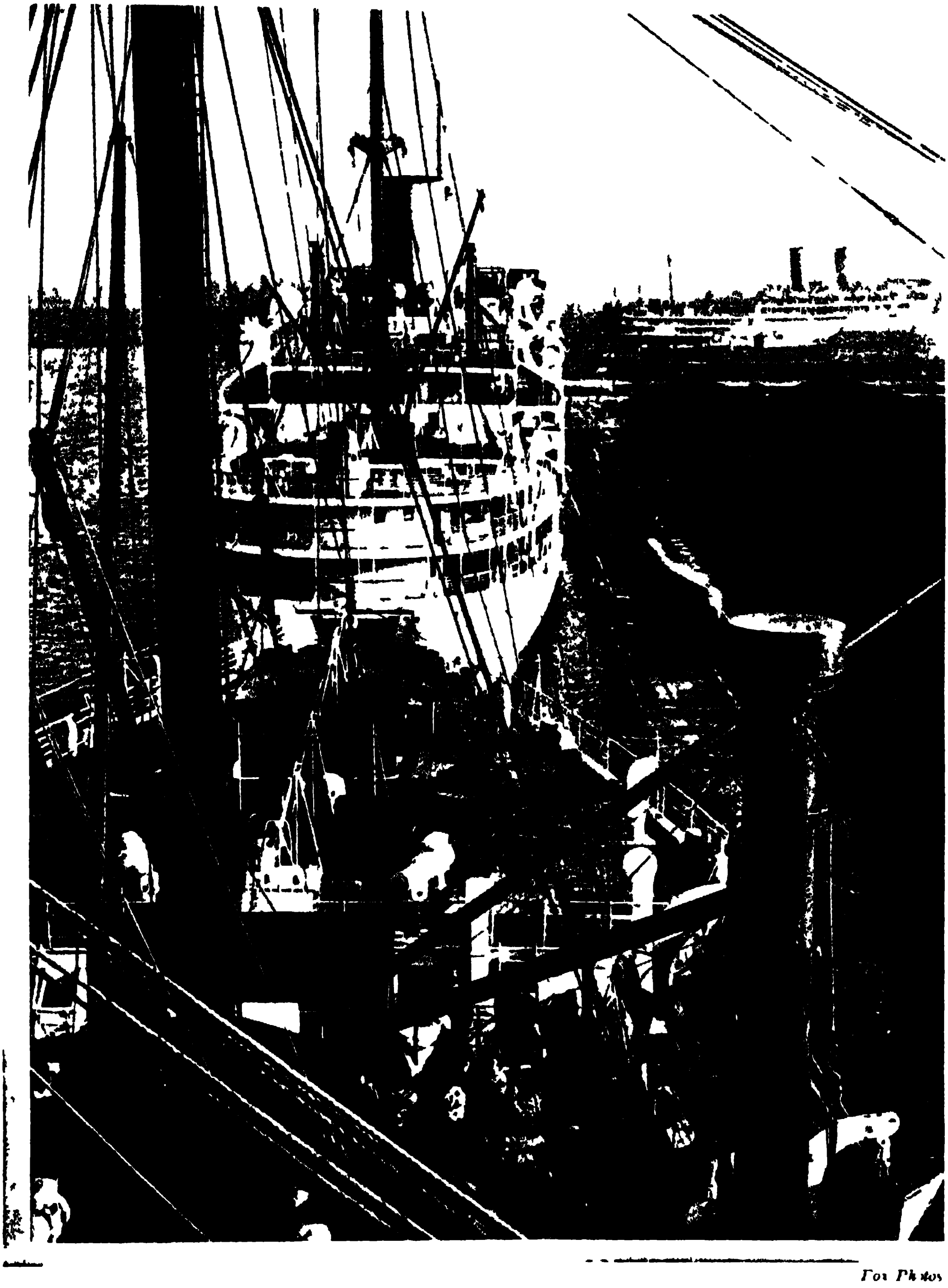
In this picture a [illegible] incident that was often repeated has been recorded by our artist. A merchant ship has been attacked while in convoy; the damage to the ship can be repaired by her own crew, but there may have been serious casualties among the crew, some of them beyond the limited skill of the [illegible]. From the light cruiser in the background a naval surgeon is being sent across the [illegible] in the Service whaler which is here seen pulling into the lee of the merchant ship. The lives of several gallant sailors are at stake, and the knowledge and skill of a Royal Navy surgeon [illegible] make all the difference to their chances of reaching the home port once more.



NELSON'S FAMOUS SIGNAL BEFORE TRAFALGAR

[illegible] important [illegible] Most famous of all [illegible] was the one flown from the [illegible] on the morning [illegible] when the French fleet [illegible] off Cape Trafalgar [illegible] Every Man Will Do His Duty" was the message [illegible] in the picture [illegible].

SHIPS AT TILBURY



Fox Photos

Though not the largest of all the big docks that make London the greatest port in the world those at Tilbury have always been highly important. They are some twenty-one miles down the river from London and have a water area of 90 acres. Our photograph gives a typical view of what Tilbury Docks are like on any day throughout the year.

gradual improvement in their food difficulties.

Instead, they had to face further small cuts in their meagre supplies. The harvests of the world had been bad. On the Continent whole sections of the people would starve unless they had bread. Nearly a year after Victory Day in Europe there was an urgent call to the British people to save bread, while other foods, instead of becoming more plentiful, were in some cases slightly reduced. Bread was rationed eventually to conserve our stocks, pending the results of the 1946 harvest in the great wheat-producing countries. And still the cry from the devastated lands of Europe was "Send us food!"

Back to the Homeland

Ships were wanted to bring food; ships were urgently needed to bring home men from the East and Middle East, the prisoners of war and internees in Japanese prison camps, and to bring home, too, some of the fighting-men who had been away from their homeland for more than three or four years. Still more ships were required to take back American, Canadian, New Zealand and other overseas troops who had been in this country or on the Continent with the armies.

Our two biggest liners were among the ships engaged in work of this kind. During the war and up to March, 1946, when she ceased her war work, the *Queen Elizabeth* steamed about a million miles and carried some 800,000 troops across thousands of miles of ocean. The *Queen Mary* had a similar record across the Atlantic and the Pacific and was then engaged in taking the English brides of American soldiers to join their husbands in the U.S.A.

Still Sailing the Seas

Not until these post-war tasks had been carried through were these two great ships released from service. Gradually our Merchant Navy began its urgent peace-time work of taking British goods to all the countries of the world, anxious to buy our merchandise after several years during which Britain had little to sell and her export trade almost ceased to exist.

Britain's great need after the lean years of war was for more imports of food and raw materials for civilian manufactures. It was even more important that her export trade should be bigger than ever in her history. We cannot buy goods in other countries without supplying them with other goods in return. British workers must have their products sold in the markets of the world and British ships must sail to every country taking those goods.

They are doing it now, and the call of the sea is still as strong as ever to the men and boys of this sea-girt island. From the fishing fleets to the great ocean trawlers, the coasters, the tankers, the big food ships that carry the meat from Australia or South America, the fruit ships, and the vessels laden with ore from Spain or with sugar from the Indies, all are needed

Brought to us Daily

They are sailing the Seven Seas from British ports to take our goods to other lands and to bring back the many things we need in this country. As Rudyard Kipling wrote years ago: -

> For the bread that you eat and the biscuits you nibble,
> The sweets that you suck and the joints that you carve,
> They are brought to you daily by all us Big Steamers—
> And if anyone hinders our coming you'll starve.

Centuries ago Francis Drake and many another great English sailor fought for the right of British sailors to take their ships wherever their merchandise was desired. The British Navy has maintained that right ever since, despite all threats of mines, torpedoes, guns and bombs, while the Merchant Navy, no matter what the risks, has never ceased to carry on its business across the deep waters of the world.

Tales of Mystery and Superstition, Smugglers, Pirates, Records and Wrecks

And Other Aspects of the Work of Ships and their Crews

ROMANCE OF THE SEA

WE have no record of the first man who shaped for himself some kind of sailing-craft and adventured forth on the great waters beyond the dry land. There must have been a beginning to the building of boats and ships, and from the dawn of recorded history the story of man's battles with the sea has held an abiding fascination for all the human race.

At best, however, man's mastery of the sea remains a strictly limited one. Every now and again the mighty ocean exerts her power to show how puny are man's strength and invention against the illimitable forces of the great waters. It is scarcely surprising, therefore, that a wonderful lore of superstition and mystery, of strange adventures and great fortunes, as well as of tragedies and evil deeds, should have gathered round the long story of the sea.

Signs and Omens

The men who went down to the sea in ships and risked their lives long before anyone had dreamt of steam-power and wireless communication were almost bound to be superstitious and to have regard for signs and omens. Luck played its part so far as the elements were concerned, and luck, good or bad, might be greatly influenced by chance happenings.

Friday was always regarded as an unlucky day on which to begin a voyage, except among the Spaniards. Did not Columbus begin his voyage to the New World on Friday, August 3rd, 1492? Not many sailors object to sailing on a Friday in these days, but to have too many clergymen aboard as passengers is still regarded as unlucky. Nor is the presence of a lawyer on board regarded as a lucky sign. Among certain nationalities, particularly the hardy Bretons, a tailor on board is certain to bring bad luck. Nor is it wise to make or mend clothes, or to have a hair-cut, during stormy weather.

To drop a bucket overboard was a sure sign of trouble, although if a sailor carried salt in his pocket he stood an excellent chance of averting evil and attracting good fortune. Finns are supposed to have control of the winds and are accordingly treated with respect. Cats are unlucky, and even a horse aboard worried some seamen of the old school, while a live hare on

board was a certain method of sending any ship to the bottom. Even rabbits were not mentioned on board ship at one time.

The albatross was regarded rather as a protective spirit. Rats, too, were looked upon in a friendly way as they gave warning when disaster threatened. "Rats always desert a sinking ship," and usually long before there is any hint of coming disaster apparent to the seamen. Old-time sailors were fond of a female figurehead on their ship as that brought good fortune, but it was just sheer bad luck to meet a woman on the way to join a vessel or to have a woman on board. "Whistling for the wind" was quite a sound practice when a ship lay becalmed, but at other times whistling on board was a dangerous amusement

An Omen of Disaster

Then there are strange stories of ghost ships such as the one commanded by the old Dutch captain, Vanderdecken, who was trying to round the Cape of Good Hope. He swore with many a dreadful oath that he would not put back into harbour till he had succeeded. Providence, becoming impatient with him, condemned him to continue his efforts till the end of time. Few seamen believe such yarns in these days of wireless and aircraft, but for a few centuries the old Flying Dutchman, Vanderdecken, was regarded as an omen of dreadful disaster.

Modern invention has robbed many of the old superstitions of their former power, and the marvels of wireless are more real than ancient ghost-ships or imaginary spirits of ill omen. It was a White Star liner, the *Republic*, which was the first to use wireless to call other ships to her aid. Badly injured in a collision at sea she sent out radio signals, and receiving ships arrived in time to take off every person on board in safety.

Radar has already proved itself an equally valuable aid when fog cuts out all visibility. When eventually all ocean-going ships are fitted with Radar as they are with wireless the dangers and perils to which voyagers have always been exposed will be reduced to a minimum. Tragedies such as the loss of the *Titanic* might very easily have been avoided if Radar had been known at that time. Wireless had begun to form part of the equipment of most big ships at that time and it played a part in this case in bringing about the rescue of nearly a third of those on board the ill-fated liner.

The *Titanic*, greatest and most luxurious liner of her day, so well built that she was regarded as unsinkable, left Southampton on her maiden voyage on April 10th, 1912. On the following Sunday night everything was well, but a quarter of an hour before midnight something caused the ship to heave. There was nothing startling in that first shock, but the *Titanic* had struck an iceberg, cutting through the bottom of the ship and smashing many of her watertight compartments.

Birth of a Great Tradition

There was no panic. Few indeed realised fully the danger that threatened and developed with such dreadful swiftness. Wireless messages were sent out and the sixteen lifeboats were manned and lowered. Women and children were ordered into them first and not till then were any men allowed in the lifeboats. The ship's band came on deck and played till the end. At 2.30 a.m. the *Titanic* stood on end and slowly slipped down into the dark waters of the Atlantic.

Right to the end the wireless operator sent out the distress signal and kept in touch with all possible rescuers. In so doing he created a tradition for a service then in its infancy, and his fine example has been followed whenever the necessity has arisen. Seven ships answered the call, but the ice hampered them. The *Carpathia*, 70 miles away when the S.O.S. came,

THE FLYING DUTCHMAN

Of all the many superstitions connected with the sea, few held their place so long and firmly as that concerned with the ghostly ship commanded by the old captain Vanderdecken. Beaten by storms in his efforts to round the Cape of Good Hope, he swore to persist if need be till Doomsday.
To have even a glimpse of this ghost ship was regarded as an omen of disaster.

Specially drawn for this work

THE LOSS OF THE "WARATAH"

On July 26th, 1909, the *Waratah* left Durban for Capetown and exchanged signals with another ship the next day. She was never heard of again. The artist who drew the above picture was aboard another ship that went through the same hurricane and was in the vicinity of the spot where it was assumed the *Waratah* went down in the tremendous seas that raged for more than a week.

steamed to the scene as quickly as possible. All those in the lifeboats were eventually found and taken on board, but they numbered in all only 711. More than twice that number, 1,513 persons, went down with the ship.

One of the blackest incidents of the war of 1914–18 was the sinking of the Cunard liner *Lusitania* off the Irish coast on May 7th, 1915. At that time, despite German threats of ruthlessness, there were certain rules of warfare which it was assumed even Germany would respect. The *Lusitania* was a passenger liner, carrying no munitions of war, and on board were a large number of passengers, including 218 Americans. Without any warning a German U-boat fired two torpedoes and within forty minutes the *Lusitania* had gone to the bottom. Nearly 1,200 people were drowned and of the Americans aboard only 79 were saved. Although America did not enter the war immediately after this tragedy there is no doubt that it was one of the important factors that eventually determined America's entry into the war in 1917.

Vanished Without Trace

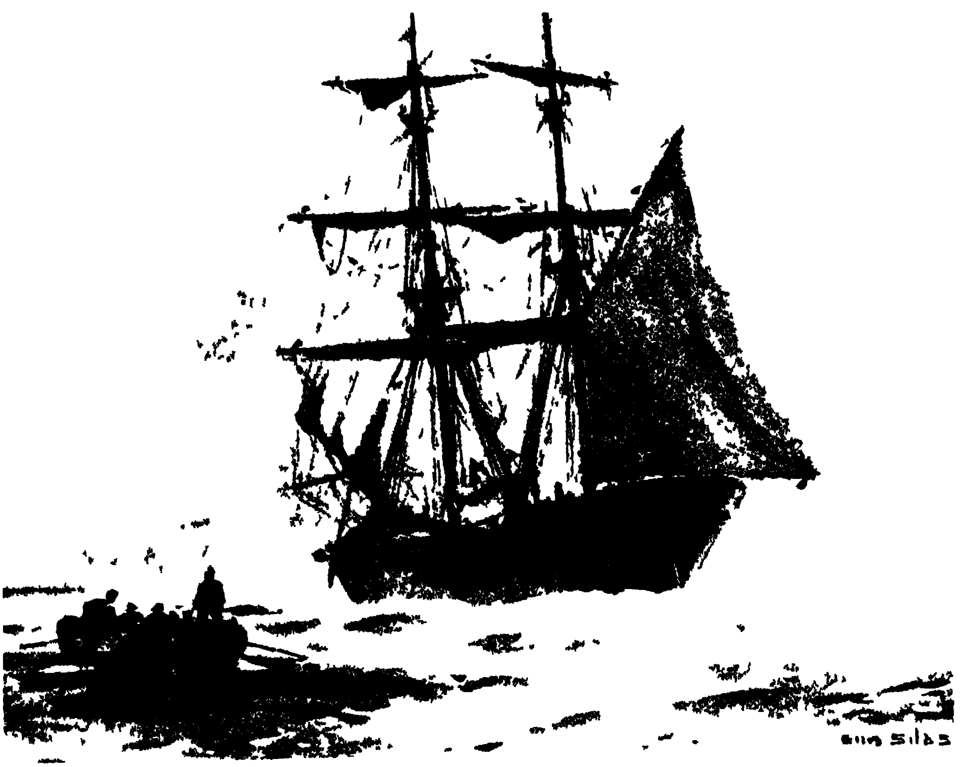
Many of the mysteries of the sea which have never been solved would in all probability not have been mysteries at all if wireless had been available. How many fine ships have sailed from port in the days gone by and dis-

appeared without trace? There was the *Pacific*, for instance, which sailed from Liverpool for America in 1856 and was never heard of again. More than half a century later the *Waratah*, a new liner of 16,000 tons, left Durban for Capetown on July 26th, 1909. On the evening of the following day she exchanged signals with the *Clan MacIntyre* as she overhauled her. That was the last ever known of the *Waratah*. There had been heavy seas and a hurricane, and the only conclusion is that the *Waratah* capsized and there was never a hope of any small boat surviving in the storm. Nor was the *Waratah* fitted with wireless, although round about that time many vessels had begun to fit the new equipment.

One of the most extraordinary of sea mysteries about which discussions have been carried on and books written over many years is the case of the *Marie Celeste*. She was a small vessel well under 1,000 tons and sailed from New York for Genoa in the latter part of 1872. She carried a crew of six under Captain Briggs, who had his wife and child on board with him. On December 5th she was sighted by the British *Dei Gratia*. Something about the vessel impelled the *Dei Gratia* captain to send a boat across to investigate.

An Unsolved Mystery

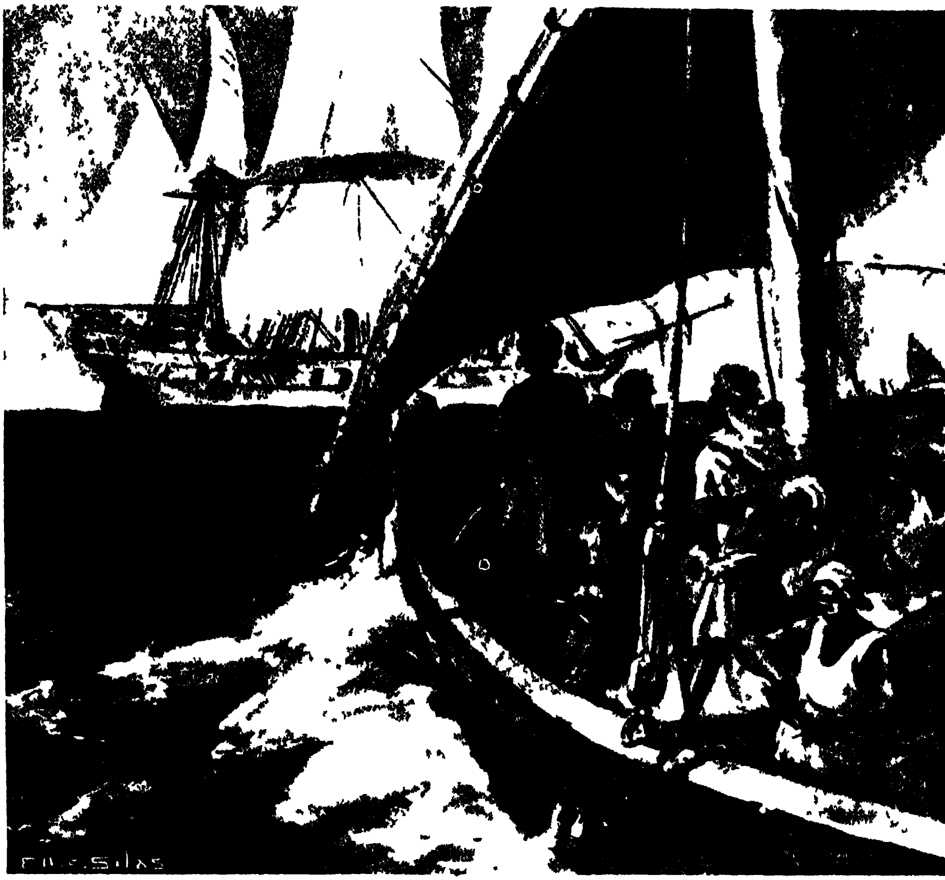
They found the ship in perfect condition and there were signs of an unfinished meal. On a table was a partially-written letter, money and personal possessions were found on board



Specially drawn for this book

MYSTERY OF THE "MARIE CELESTE"

In 1872, the *Marie Celeste* was found off Gibraltar without a soul on board and yet in perfect condition. Nothing was ever heard of her crew and the mystery of why they abandoned the ship in calm seas has never been solved and after the lapse of years is never likely to be



Specially drawn for this work

THE BARBARY PIRATES

During many centuries the pirates of the Barbary coast, North Africa, made the Mediterranean a sea of danger and peril. Many countries at different times tried to wipe them out, but they persisted till 1830 when they were finally driven out of business. Our picture shows the pirates closing in on a ship that is lying becalmed and helpless.

The log was written up to November 24th but the slate log had been entered up at 8 a.m. on the following day. There was no sign of any collision or anything at all to account for what had obviously been a sudden abandonment of the vessel since there was not a soul on board. Why? What had happened to the captain and his company?

Theories have been put forward and on one occasion at all events a man who professed to have been a member of the crew left behind him his story of what had happened. Unfortunately some of his details did not fit the facts and there was no member of the crew bearing his name among those who sailed with her. He merely added to the mystery. Why, as his story did not reflect on anyone, did he not tell it while he was alive? There was no answer to that query, or to several others that arose, and the full truth about the *Marie Celeste* is never likely to be revealed after all these years.

Pirates and Privateers

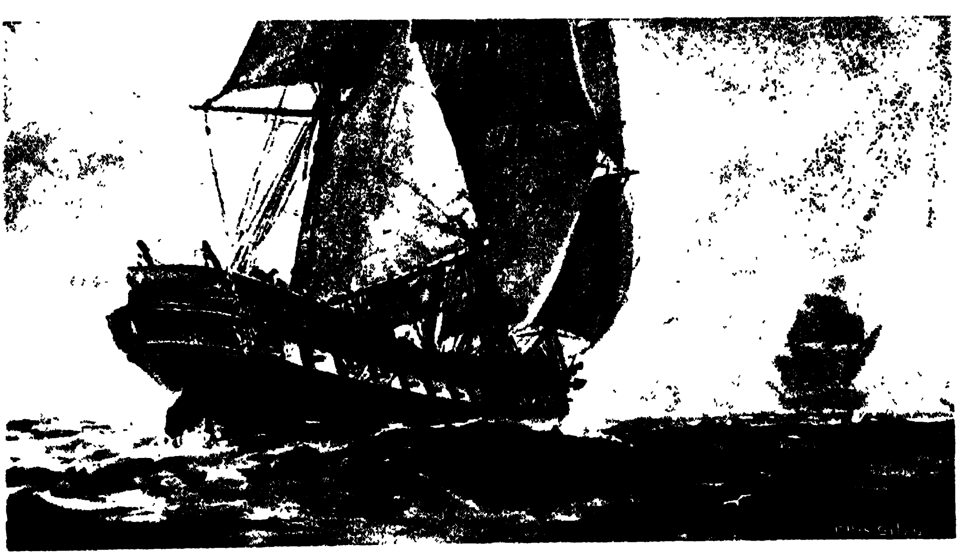
The passage of time often adds a false atmosphere of romance to things which were utterly brutal and sordid.

Thus the pirate and his flag bearing the skull and crossbones have acquired through the years something of the air of a gentleman adventurer of the sea. Some pirates, it is true, were magnificent sailors with a courage that dared all risks and dangers, whether from the sea or from men.

The pirate appeared on the scene almost as soon as trading vessels first put out to sea. Homer and Herodotus wrote of them, and in the days when Rome was paramount the pirates flourished. Julius Cæsar, in his earlier years, was captured and held to ransom by them. Released when his ransom was paid, Cæsar made his plans, returned to the pirates' lair and captured the lot, numbering nearly 400. In due course every one of them was executed.

In the Mediterranean the Barbary corsairs have at different times during many centuries made piracy into a very popular and paying profession. Not only natives of those shores, but adventurers from England and other European countries joined with the pirates of North Africa to plunder ships and to take men and women as slaves, or hold them to ransom. Cromwell sent an expedition against them in 1655, and right down to the nineteenth century the English, French, Dutch, and later the United States of America, fought against them. In 1816 Lord Exmouth bombarded Algiers and was able to release hundreds of captives. It was bombarded again in 1824, but in 1830 the French conquered Algeria and the days of the Barbary Pirates were over.

On the Spanish Main both piracy and privateering flourished, especially in the days of Queen Elizabeth. The pirate made no claim to patriotism, but robbed any ship for his own gain; the privateer carried on his work much as the pirate did, but only against ships belonging to a country with which his own country was at war. Drake, for example, with some of his companions, held "Letters of Marque," a Royal commission to attack the merchantmen belonging to the enemy. Queen Elizabeth I used some of her money to



Specially drawn for this work.

A PRIVATEER CHASES ITS PREY

Often enough a privateer was little better than a pirate, but he held authority in some form from his country to attack all merchantmen of any country then at war with his own. Here we see a "private" warship giving chase to an enemy merchantman in the hope of valuable booty.

fit out Drake's ships and drew her share of the plunder.

Morgan of the Spanish Main

When the Spaniards protested to her against "El Draque," the terror of the seas, and demanded that he should be hanged, Elizabeth gave her answer by knighting him. Another man who gained a knighthood after earning fame as a pirate was the bold Harry Morgan (1635–88), who sacked Porto Bello and later Panama. England was not at war with Spain, and, quite reasonably, there were strong protests from the Spaniards about Morgan's conduct. The result was that Morgan was in due course sent home for trial. Charles II took a strong liking for him, made him Sir Henry Morgan, and sent him back as lieutenant-governor of Jamaica, where he did his best to suppress piracy.

Long Ben and Captain Kidd

Another famous pirate was Captain John Avery, who was second-in-command of a merchant ship in 1794. "Long Ben" became a pirate by way of protest against his Spanish employers who failed to pay the crew's wages. Avery took the ship and made his head-quarters in Madagascar. His victims were mainly those ships taking Mohammedans from India to Mecca, and among his prizes was the Great Mogul's own ship. Having acquired sufficient treasure Avery retired to England, but discovered too late that there were sharper pirates on land than there were at sea, and they succeeded in relieving him of all his ill-gotten wealth. Eventually the bold buccaneer died in poverty.

There were other pirates such as Captain Edward Teach and Captain William Kidd. There was little of the hero about Kidd nor does he appear to have been a very successful pirate. Eventually he was captured, tried and executed in 1701

Except for a certain amount of business in the China seas the buccaneer and pirate died out completely with the coming of the steamship. But the stories of pirates' hidden hoards of treasure lived on much longer. Captain Kidd was reputed to have buried several fortunes on lonely islands, but only one of these fortunes was ever found and that was recovered almost immediately. True, there were gold and jewels, calico, canvas and bags of sugar. From this the lawyers and others were paid and the rest went to Greenwich Hospital.

Treasure in Deep Waters

There has been, and still is, buried and sunken treasure. H M.S. *Lutine*, laden with gold and silver bullion worth over a million pounds, went down in 1799 off the Dutch coast. At different times a fair amount was recovered, but the last effort in 1911 showed that the wreck was embedded deep down in the sand and work was impossible. One relic was recovered round about 1860 and is well known to-day. The *Lutine* ship's bell is now used at Lloyds to warn underwriters that important news of ships is about to be announced. Altogether bullion to the value of about £100,000 had been recovered by 1861, but later efforts have been unsuccessful.

One of the most famous sea treasures is the Armada galleon, sunk in Tobermory Bay. The name has sometimes been given as the *San Juan Bautista*, but is now generally believed to be the *Florencia*, pay ship of the Armada. The value of the treasure on board has been estimated at different times at sums ranging from £300,000 to £30 million. Guns, goblets and coins have been recovered, and special expeditions have attempted to get through the silt in which the wreck is now deeply buried. Then in March, 1950, the Duke of Argyll enlisted the aid of the Admiralty and naval divers went down. The wreck was located but it was so deeply embedded in the sand that the task was reluctantly abandoned.

The story of the Cocos Island trea-

THE TREASURE OF COCOS ISLAND

Specially drawn for this work

In 1818 a British pirate, Bennet Graham or Benito Bonito as he preferred to call himself, buried loot taken from Peruvian churches on Cocos Island. More wealth was added later by Graham's partner Thompson. Both men died before they could recover the treasure, and since then, right down to 1940, expeditions have gone to Cocos in the hope of finding the buried treasure.

Specially drawn for this work

A REVENUE CUTTER OVERHAULS A SMUGGLER

For more than a century from 1730 onwards, smuggling was a flourishing business along our Southern coastline. The efforts made to prevent this illegal trade were often too weak to stop the smugglers, but occasionally one of the Government Revenue cutters seized a chance and captured the vessel carrying contraband to the smuggling band ashore.

sure dump begins about the year 1818 when a British pirate, Bennet Graham, or Benito Bonita as he preferred to call himself, brought the loot from Peruvian churches and merchant ships to be buried on Cocos Island until he could collect it later. It is fairly certain that more wealth was added to this dump later.

Fortunes from Spanish Grandees

With Bonita was William Thompson who turned up at Cocos Island again in 1821. The Spaniards had managed to get away much of their treasure from Lima when Peru was in revolt against the rule of Spain. Lord Cochrane, then in command of the Chilian Navy and giving help to Peru, went to the port of Callao, to which the treasure had gone, and demanded two-thirds of the money with which to pay his men. On the scene appeared Thompson, now in command of a trading brig *Mary Read*. He arranged to take off some of the Spanish grandees with their enormous fortune and avoid Lord Cochrane's attentions. What had happened to Bennet Graham nobody apparently knew.

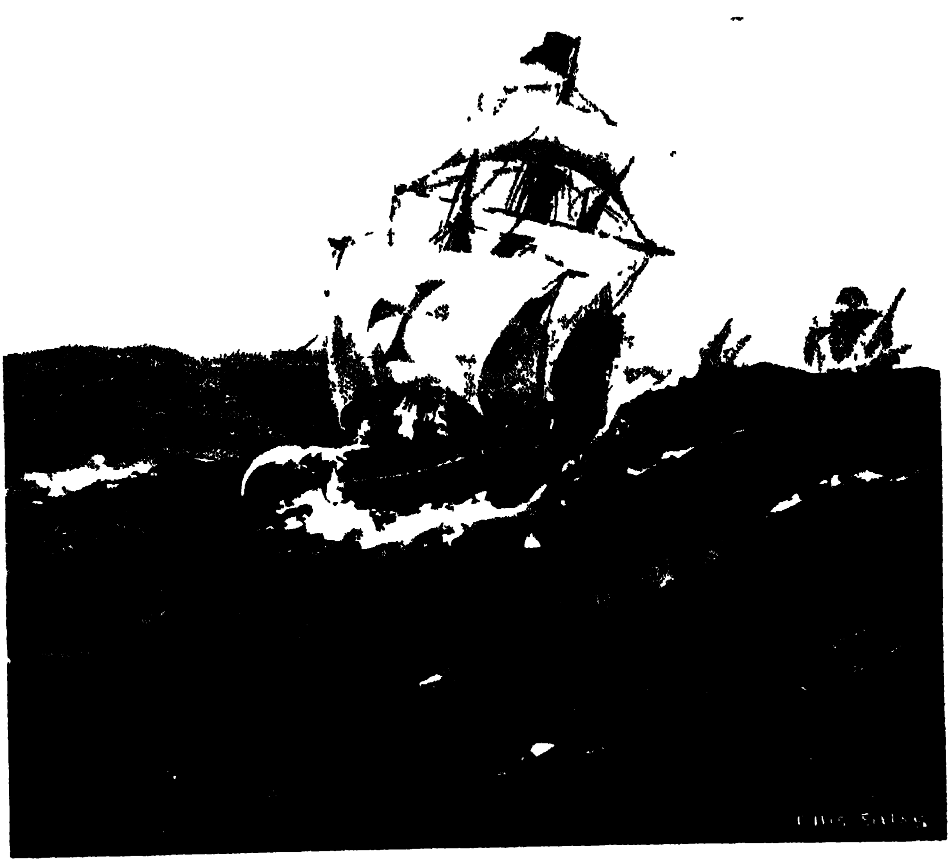
As soon as the *Mary Read* with the escaping Spaniards and their wealth was well clear of the port the helpful Captain Thompson killed the Spaniards and flung them overboard, then set sail for Cocos Island to bury his share of this

additional loot. Unfortunately it was many years before Thompson had a chance of returning to collect his vast wealth. When he did at last manage the return voyage he took a partner with him and discovered that both the treasure of Bonita (Graham) and Thompson's own were untouched. It was too risky to take away just then and Thompson and his partner, Doig, made careful preparations for another voyage.

Thompson died without ever seeing his treasure again, but in due course some years later, his partner, Doig, with his son, went out to Cocos once more, all prepared to bring home their great fortune. Unfortunately a landslide had occurred and made the recovery of the treasure a serious engineering task. They were totally unprepared for anything of that sort and had to return home to consider their plans.

Treasure Trove and Salvage

The elder Doig died and the son never had a chance of going out again, but he left clear directions regarding the location of the treasure hoards. Many expeditions have been made and a few coins and ornaments have been found in circumstances which certainly help to confirm the story. Most of the



Specially drawn for this work

THE FIRST ATLANTIC CROSSING

In 1492 three little ships *Santa Maria*, *Pinta* and *Nina* under the command of Christopher Columbus made the first crossing of the Atlantic in [illegible] days. Many thousands of crossings have been made since then and many ships have held the record for a time. In 1952 the American liner *United States* did the crossing in 3 days, 10 hours 40 minutes.

seekers, however, have done just as much to obliterate helpful landmarks as have the storms and natural changes through the long years which have elapsed since Thompson buried his loot.

Yet there are reasonable grounds for the belief that there is still a very considerable fortune buried somewhere on Cocos Island, but the modern treasure-hunter would need to be equipped with excavators and other engineering machinery and to have plenty of time to spend on the task. There have been several attempts in comparatively recent years, usually in a fairly light-hearted spirit, with a limit on both the time and money to be expended on the task. Quite possibly it would take more money to recover the treasure than it would be worth if and when it was finally unearthed.

Commercially the salvaging of sunken treasure from ships that have gone to the bottom when carrying known wealth, such as the *Lutine* already mentioned, is a task for experienced divers, armed with scientific equipment and assisted by skilled technicians. Some truly remarkable jobs have been carried out by skilled salvage companies, but this is essentially a business undertaking in which the actual cost of carrying through the necessary work is carefully estimated and balanced against the certain known value of the completed task.

Planet

THE "LUTINE" BELL AT LLOYDS

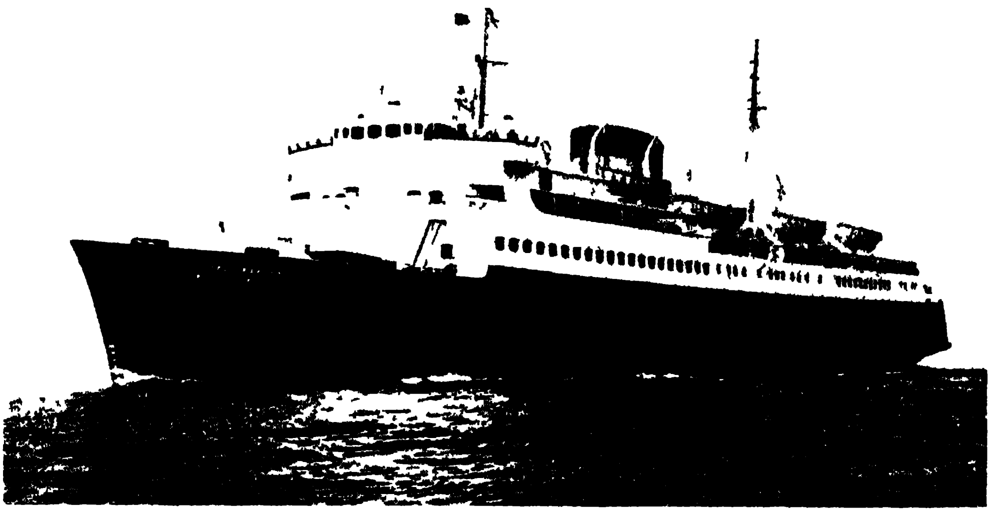
Our photograph shows the Rostrum at Lloyds with the caller ringing the *Lutine* bell. One stroke is the signal that bad news is about to be announced while two strokes indicates good news is coming. The bell was recovered in 1859 from H.M.S. *Lutine*, wrecked off the Dutch coast in 1799.

When Smugglers Flourished

Salvaging is a modern business to some extent, but there was one flourishing business connected with the sea which, like piracy, has acquired an atmosphere of romance with the passage of time. For more than 100 years, from 1730 onwards until well into Queen Victoria's reign, the business of smuggling could fairly be classed as one of Britain's industries.

At one time, round about 1740, it was calculated that only

A MODERN CAR FERRY



Cars and double decker buses can be carried comfortably on board the newest and biggest car ferry vessel the *Lord Warden* which went into service between Dover and Boulogne in the summer of 1952. It can carry 1,000 passengers and 120 cars and in the ship's garage is a turntable so that the cars can be swung round ready to drive off

Photos: Central Press

In this picture the first cars are seen running down the ramp to pass through the steel doors at the stern when boarding the vessel for the cross-Channel trip

"First on first off" is the principle on board the *Lord Warden* and the first car is seen here as it was driven off the ship on to the special ramp at Boulogne

one-fifth of the four million pounds of tea which came into this country paid its fair share of duty. One fleet of five fast cutters running contraband between France and the South-East coast were believed to bring in some six tons of tea and 8,000 gallons of brandy every week. There were men in several of the Southern seaboard counties who built up big fortunes as smugglers and were regarded as comparatively respectable citizens.

A Battle for Tea

Some of the smugglers, particularly in the Western counties, most certainly did not regard themselves as criminals, but as members of a straightforward profession who were merely concerned with outwitting, or possibly, bribing, the preventive men, whose unenviable task it was to stop the smugglers if they could. Usually, however, the forces employed by the Government for this purpose were utterly inadequate for the task. Sometimes the preventive men were supported by Dragoons, and occasionally pitched battles took place in which the Government forces were as often as not utterly routed.

The most infamous of all smugglers were undoubtedly the members of the Hawkhurst gang. They were led by a couple of out-and-out scoundrels, Kingsmill and Fairall. Usually the smuggling fraternity kept on the best of terms with local residents who often received some benefit. The Hawkhurst gang terrorised a whole district after their first notorious affair in 1744 when they captured a revenue patrol of four men, two of whom were released eventually after being badly beaten. What happened to the other two was never known, but it was said that these two had originally been members of the gang and had then deserted.

One of the Hawkhurst gang's most daring outrages was the capture of Poole Custom-house in October, 1747, to take a quantity of smuggled tea which had been captured by the authorities. Sixty armed men took part in the attack and removed the tea. As the proceeds of this affair amounted to only 27 lbs of tea per man, it scarcely seems to have been worth while.

Their outrages included the killing of a number of persons, and finally the authorities were compelled to make a determined effort to break up the gang and capture the ringleaders. It was a fairly long struggle, but at last, in April, 1749, Kingsmill and Fairall were captured and paid the penalty of their crimes.

Not all smugglers were in the Hawkhurst gang class, but there were few people willing to turn informer in any case. Rudyard Kipling, in one of his poems, sums up the general attitude in the advice: "Don't go drawing back the blind or looking in the street." And again:

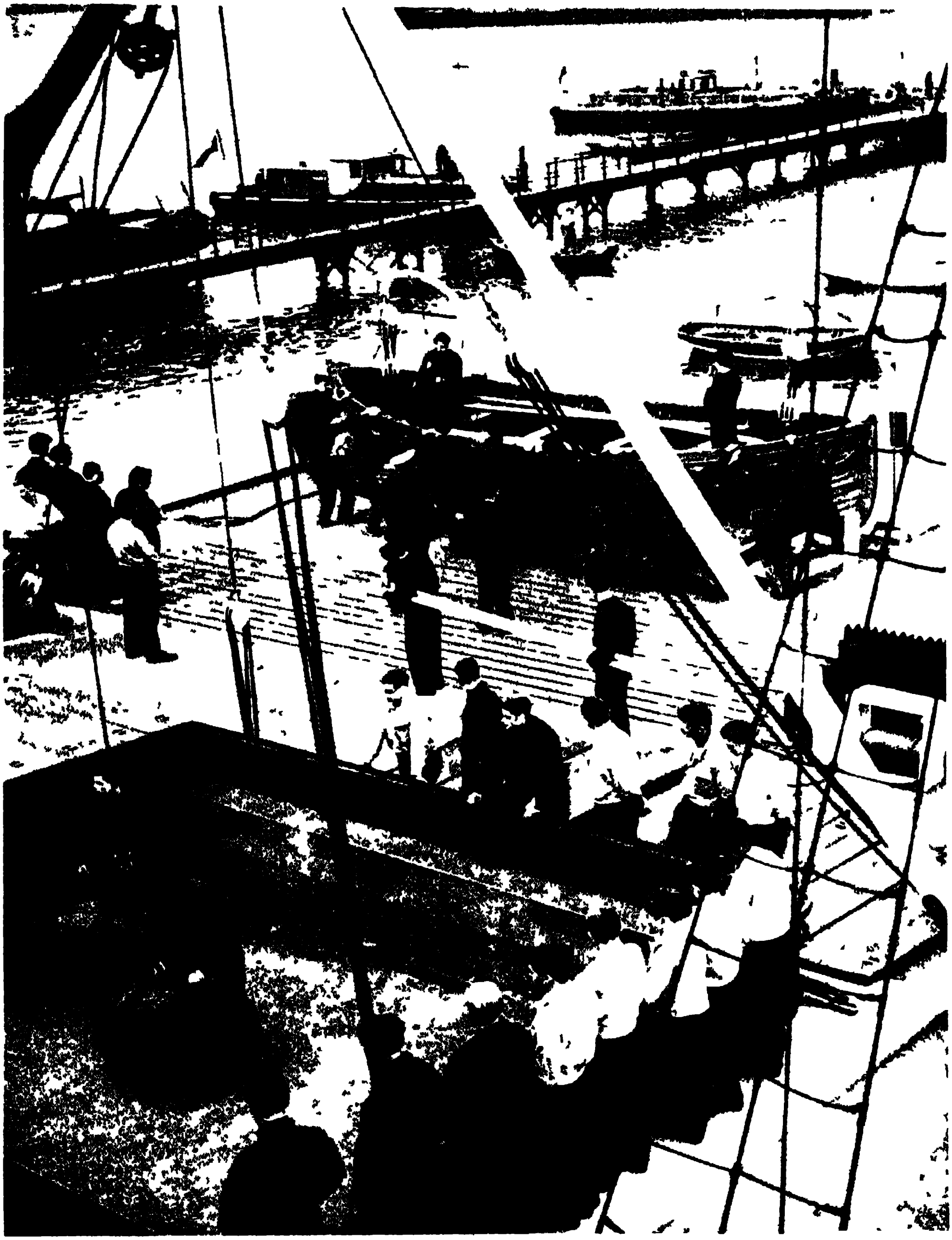
"*Five and twenty ponies, trotting through the dark—*
Brandy for the Parson, 'baccy for the Clerk;
Laces for a lady, letters for a spy,
And watch the wall, my darling, while the Gentlemen go by!"

In some parts of the country a farmer would be warned to leave his stables and cart-sheds unlocked on a certain evening. The wisest course was to obey; if he refused there was more than a chance that his ricks would be fired and cattle maimed, just by way of a lesson to teach him better manners. If he complied—the horses would be in their stables next morning, a little the worse for a hard night's work perhaps, while in the cart-shed, somewhere near the carts which had been used, there would probably be a tub of spirits or bag of tea.

Aid from Parson and Ploughman

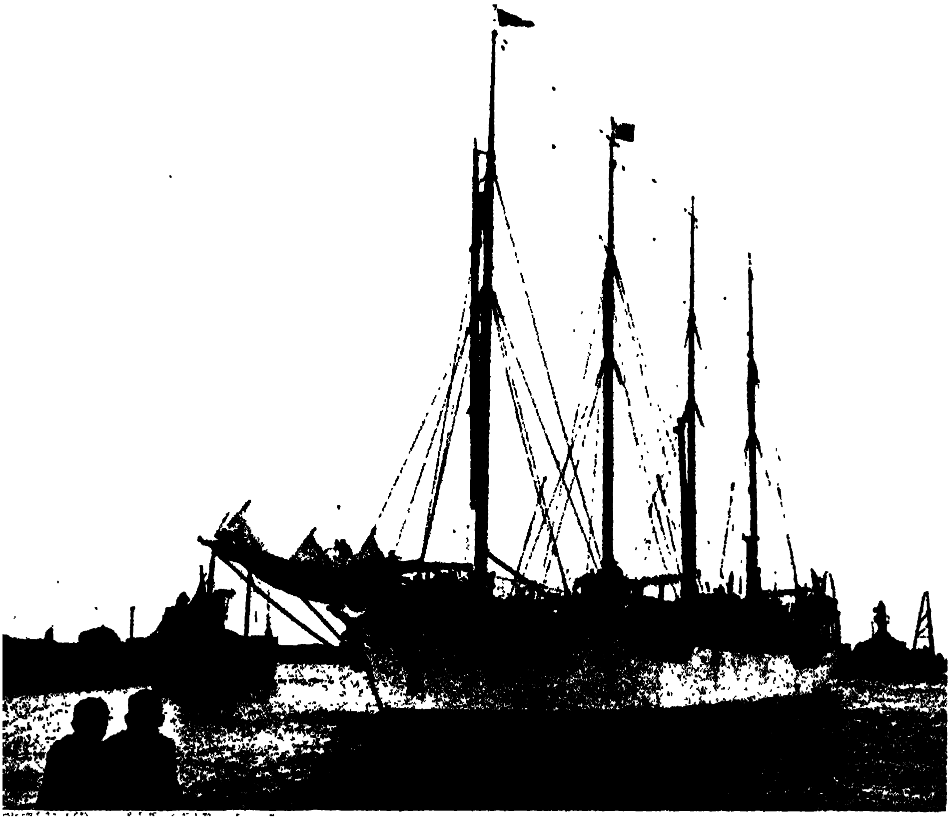
It was obviously better to fall in with the smugglers' ideas of friendly aid even though the farmers objected to smuggling on several grounds, chief of which was that the trade attracted too many of their labourers. It was a temptation to many an honest ploughman, who

TRAINING FOR LIFE AFLOAT



Fox Photos

In the old days a boy learnt the art and science of seamanship in the hard way by practical experience at sea. To-day he goes through a properly planned course of training both ashore and afloat before he is signed on as a member of a merchant ship's crew or becomes a Royal Navy rating. Here we have two classes in such a training school for seamen. In the foreground the way to hitch a rope round a barrel for unloading is being taught, while beyond can be seen a group engaged in the task of lowering a ship's boat over the side.



Planet.

TIMBER COMES TO BRITAIN UNDER SAIL

Few sailing-ships are employed in overseas trade to-day but they have not entirely disappeared. Our picture shows the Swedish 4-masted schooner *Albatross*, used in recent years as a training-ship, back at work again after the end of the war in 1945. Her cargo was much-needed timber for Britain's housing drive, and she is here seen entering Lowestoft harbour to unload.

earned sixpence a day, to become a rider for the smugglers at half-a-guinea a journey, with probably enough tea as a little extra present to enable him to make a pound or so.

Some of the magistrates were hand in glove with the smugglers, and not a few clergymen gave useful assistance, as did the sexton and the clerk in suitable parishes where it was convenient to use the crypts as temporary store-houses for smuggled tubs of brandy and bags of tea.

Even the Navy took a hand during the early years of the nineteenth century in trying to prevent smuggling. Britain was at war with France, but those engaged in the smuggling business on both sides of the Channel ignored the question of enemy nationals. British smugglers were welcome enough in certain French districts where the goods they collected for running across the Channel were paid for in gold.

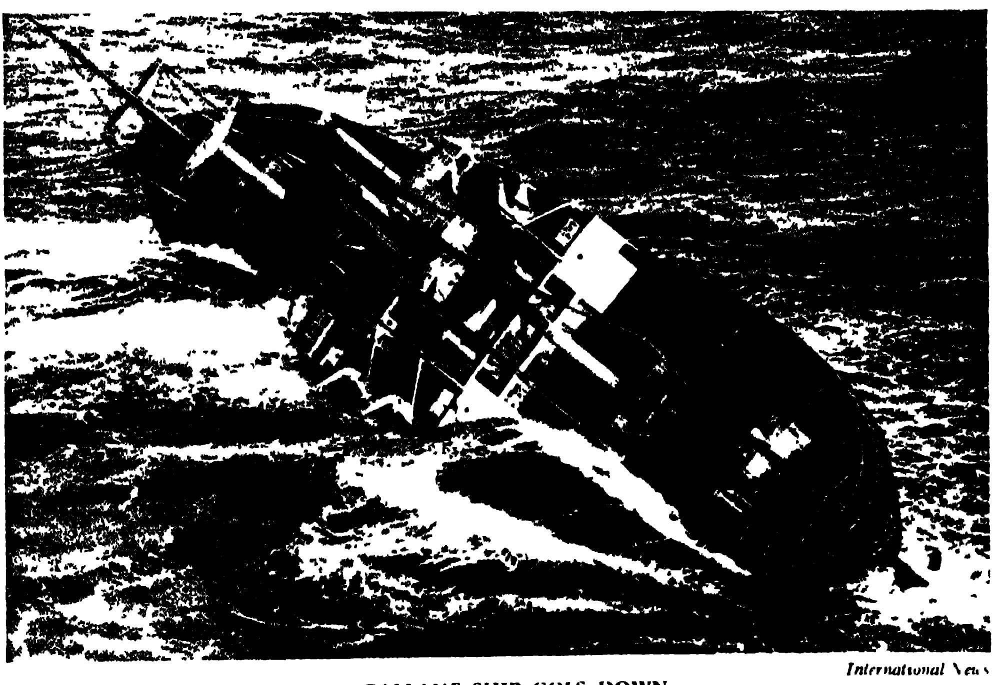
This gold was quite useful to France, but was a real loss to Britain. There was no reason whatever why the French police should interfere, nor why the French Army should worry about British smugglers who were often very useful in taking secret letters to their spies in England. Eventually coastguards were established and became a highly efficient and useful body of men.

Other steps were taken in addition, and the coming of steamships was a last nail in the coffin of the dying profession of smuggling. It had ceased to be quite such a profitable game before then and the rewards were inadequate compared with the increased risks. There has, of course, been some little revival of smuggling in a new form in our own day, and aircraft have taken the place of the fast-sailing cutters slipping across Channel before a favourable wind. But smuggling by air is an exceedingly risky business and the penalties extremely heavy. The records so far indicate very definitely that there is no future in it!

Blue Riband of the Atlantic

In recent times there has been a revival of the old-time rivalry to lower the record for the crossing of the Atlantic. Until 1952 "the Blue Riband of the Atlantic" was held by that fine ship the *Queen Mary*. In August, 1938, she beat her own previous record by making the crossing in three days, twenty hours and forty-two minutes. Then the fourteen-year old record was beaten by the American liner *United States* on her maiden voyage in July, 1952, with a record for the 2,938 miles from Bishop Rock Lighthouse off the Scillies to the Ambrose lightship in New York Bay of three days, ten hours, forty minutes.

That first historic voyage by Christopher Columbus in 1492 took seventy days. The marvel then was not so much the time as the fact that he had managed to get across and to return again. It was not till the middle of the nineteenth century that anybody really began to trouble about speeds and records. In July, 1840, the *Britannia*, owned by the newly-formed Cunard Company, made the voyage from Liverpool to Halifax in a little under



International News

A GALLANT SHIP GOES DOWN

A stirring story of the sea was recorded in January, 1952, when Captain Carlsen of the *Flying Enterprise* ordered his passengers and crew to abandon ship. The captain remained on board, despite the hazardous list. An Admiralty tug reached him, and the mate, Mr. R. K. Dancy, managed to swing aboard. Despite all efforts, however, Captain Carlsen and Mr. Dancy had eventually to leave the ship only a very short time before she went down off Land's End.

twelve and half days. This beat the *Great Western's* record, made two years earlier, of fifteen days for the outward crossing.

Some of the old sailing-ships had put up remarkable records, but the steamships drove them out of business. For some years the real contest for supremacy lay between two British shipping companies, the Cunard and the White Star, which were then separate companies. In 1850 the Cunarder *Asia* did the voyage in 8 days 17 hours.

The Battle for Honours

For the next thirty years or more there was continual competition to hold the record for this particular crossing, which eventually became known as the Blue Riband of the Atlantic, though there was no ribbon and no prize at stake. The White Star sister ships, *Teutonic* and *Majestic*, shared the honours in 1891, but were beaten by the Cunard *Campania* and *Lucania* two years later. German shipping companies then entered the contest, and in 1897 the *Kaiser Wilhelm der Grosse* crossed from Southampton to New York at an average of 21·39 knots, and on the return voyage at 21·95 knots.

Other German ships that maintained the supremacy were the *Deutschland*, *Kronprinz Wilhelm* and *Kaiser Wilhelm II*. Then came the ever-famous *Mauretania* in 1909, which did the Queenstown to New York trip in four days ten hours at an average speed of 26·06 knots. The *Titanic* was expected to wrest the honour from the Cunarder, but the tragic ending of her maiden voyage not merely ended all such hopes, but for a time raised doubts about the wisdom of this attempt to knock a few hours off the record.

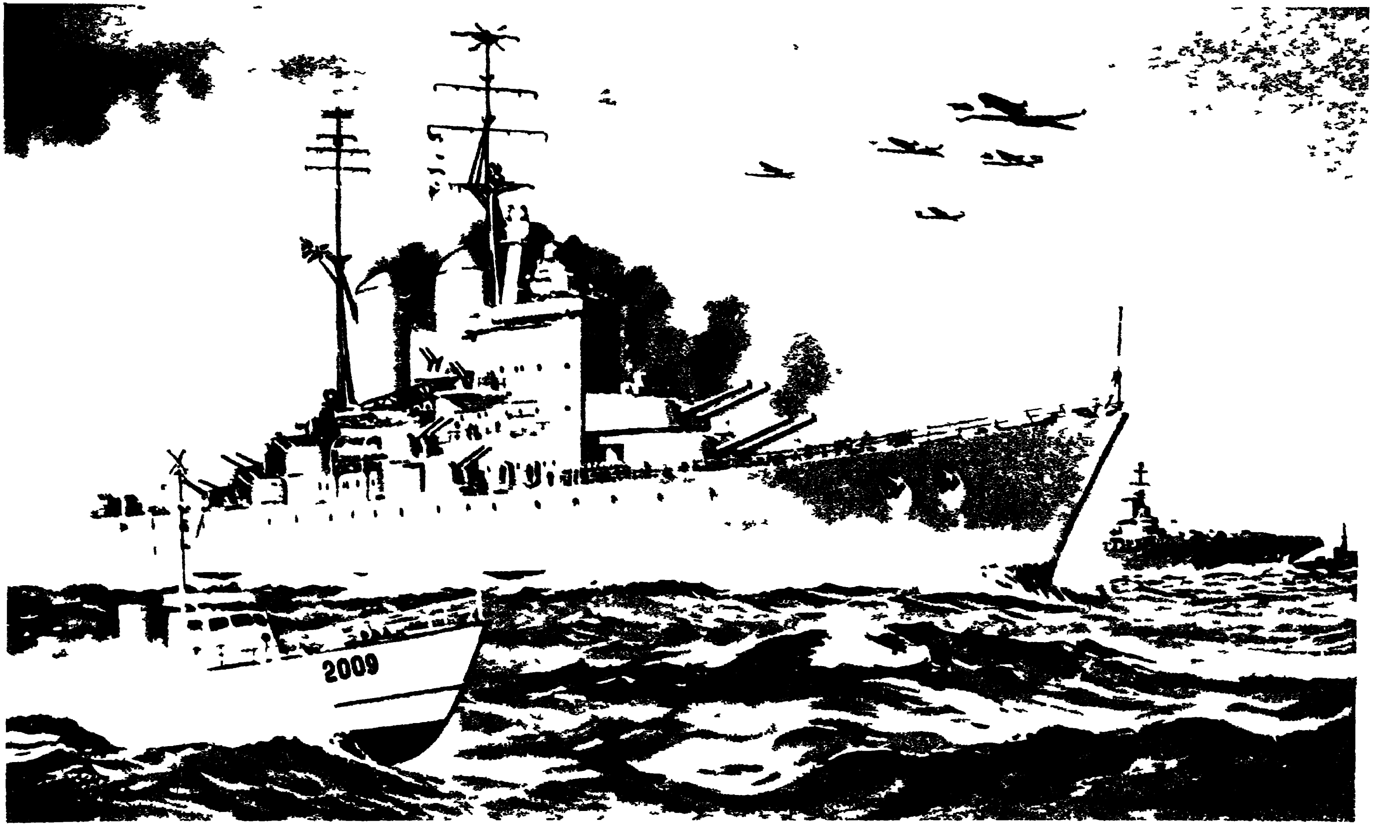
The Great War of 1914–18 came and the *Mauretania* record remained unbroken until 1929 when the *Bremen* took the honours for Germany, averaging 28·51 knots, followed in 1933 by the Italian liner *Rex*, which averaged 28·92 knots on her 3,188 miles run from Gibraltar to New York. In May, 1935, France took pride of place when the *Normandie* made a new record on her maiden voyage by crossing in three days twenty-one hours forty-five minutes at an average speed of 30·1 knots, increased to 30·31 knots on her return voyage.

It was in August, 1938, that the Cunard White Star liner *Queen Mary* did the run in three days twenty hours forty-two minutes, and the Blue Riband was held by Britain again for fourteen years. The World War temporarily ended all efforts to lower this record. There was more arduous and dangerous work for the *Queen Mary* to do. Six years of war service stood to her credit when in August, 1945, she came back for overhaul and refitting at Southampton Docks. Her record was eventually beaten by ten hours by the American liner *United States*, as already mentioned, at an average speed of 35½ knots.

Superstitions Pass but Courage Remains

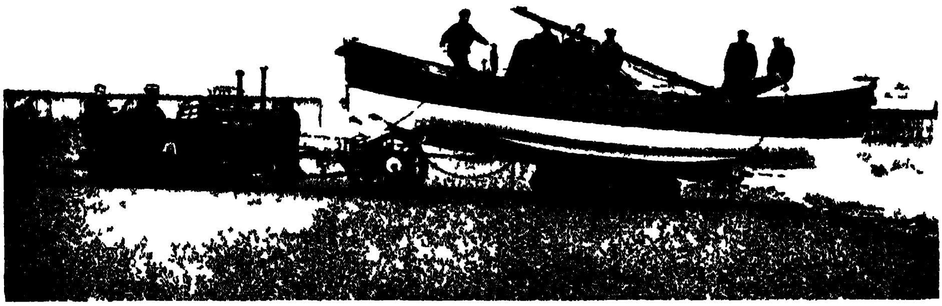
The old superstitions are dying, the pirate and the smugglers have gone; the wooden walls and the graceful clippers have given place to more solid-looking ships of steel and iron, with great funnels leaving a long trail of smoke behind them, while the masts carry wireless aerials but no sails. The sea shanties are sung by land-lubbers and the sailor a thousand miles from land listens-in to the latest news from London.

But the sea itself is unchanging and its perils have not been utterly banished. Nor has the spirit of the men who sail from our ports changed since the days of Drake and Hawkins. The long traditions of courage shown by British sailors have not been tarnished during those recent years of direst peril when our ships were the lifeline of this country. Our sea-girt isle still stands impregnable and for that great blessing the chief credit goes to the men of the Royal Navy and their brothers in the Merchant Navy.



BRITAIN'S LARGEST BATTLESHIP, H.M.S. VANGUARD

LIFE-BOATS AND THEIR CREWS



R.N.L.I.

A LIFE-BOAT AND ITS CARRIAGE

This is a picture of the 35 feet 6 inch motor life-boat which is stationed at Skegness. For launching at the water's edge it is mounted on a carriage having traction units and drawn by a tractor. These mechanical aids greatly facilitate the work of getting the vessel afloat quickly.

ANY work dealing with ships and seafaring matters would be sadly incomplete without some reference to the work of the Royal National Life-boat Institution, its boats and their heroic crews. From the little fishing coble to the great liner, and even to the ships of the Royal Navy, there is no class of sea-going craft that has not at some time or other been helped by the lifeboatmen.

A life-boat is, of course, a specially-designed craft for saving life from shipwreck and must be able to weather storms in which other boats would founder. One or two attempts had been made to design such a craft before three Englishmen, Lionel Lukin, William Wouldhave and George Greathead, all tackled the problem about the same time. Each of them contributed something to the building of the first life-boat which was launched at Newcastle-on-Tyne in 1789. For thirty years this first life-boat was in use and saved hundreds of lives.

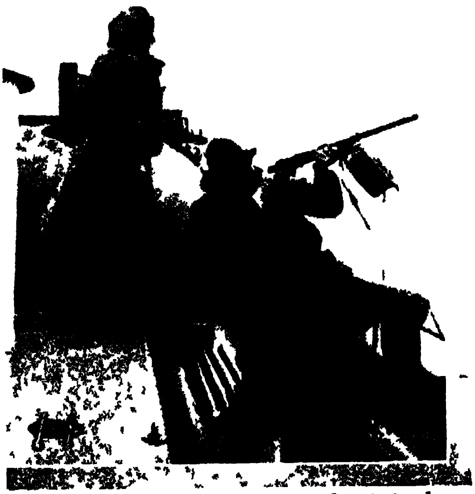
What is the difference between a life-boat and any ordinary boat? In the first place the life-boat is very much stronger in build. For the stem, stern and framing English Oak is used entirely, and for the planking there is African mahogany. Burma supplies the teak for the keel, while from Canada comes the Western Red Cedar used for the air-cases.

To Ensure Buoyancy

This brings in the second important difference: the life-boat is fitted with air-cases and chambers to make her specially buoyant and she is able to free herself quickly of water through valves or scuppers fitted in the bottom or sides. These valves are so made that they empty the water in a few seconds but allow none to return. If you were to fill the deck of a life-boat with water right up to the thwarts she would empty herself in twelve seconds.

There may be from seven to fourteen water-tight compartments and this means that, should the vessel be damaged, only a small part of the craft can become flooded. There are from 70 to 160 air-cases, and these make her practically unsinkable. A life-boat can be kept afloat by her air-cases even if every water-tight compartment is badly damaged and wide-open to the sea.

STERN WORK FOR THE LIFE-BOAT'S CREW



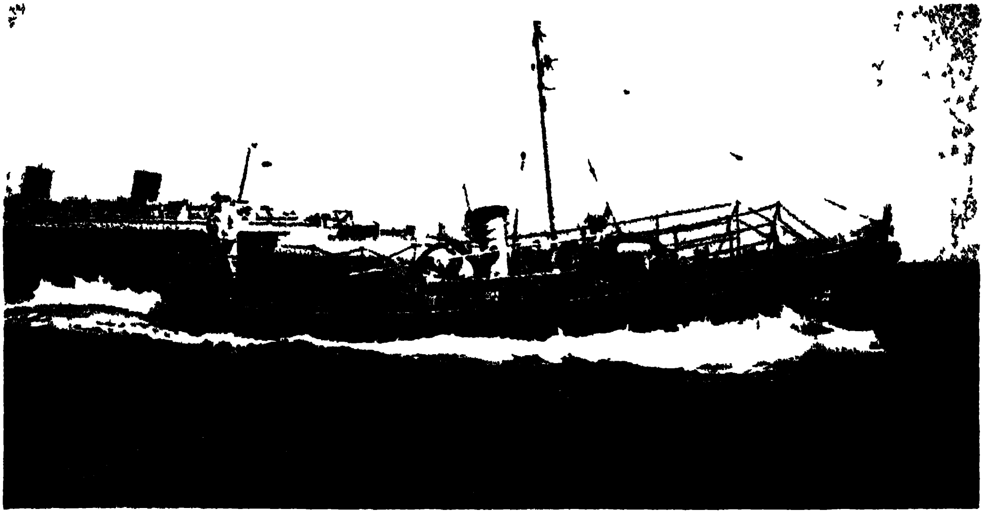
Here is a line throwing gun about to be fired The photo was taken on board the Yarmouth Isle of Wight life boat and you see how the line is coiled in a case

On many a winter's night sheer darkness may interfere with the work of rescue Modern life boats are therefore equipped with searchlights

Graphic Photo Union

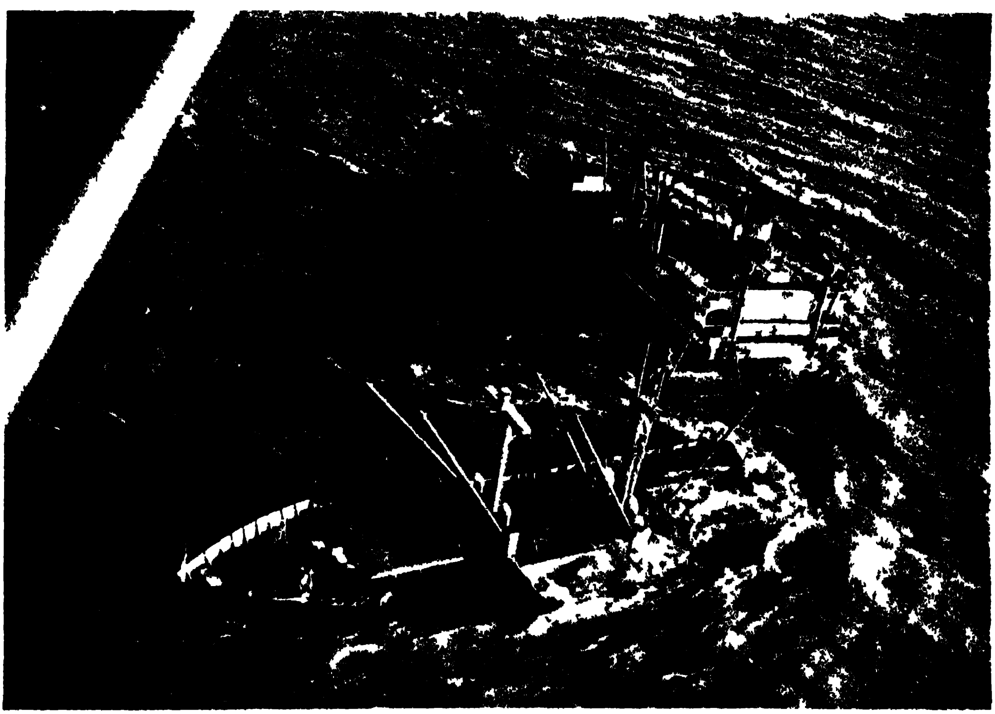
During a storm and in the dark hours of the night the Greek steamer *Varvassi* was driven on to the rocky Needles off the Isle of Wight With heavy seas pouring over her the ship was in danger of total destruction The Yarmouth (I O W) life-boat put out and rescued the thirty-five members of the crew on board

"FOR THOSE IN PERIL——"



R.N.L.I.

All life-boats are now being built with two engines and twin screws and are entirely independent of sail on which they relied for so long. The last of the sailing boats was replaced by motor boat 1948. To-day there are over 150 motor life-boats stationed round our coasts. These life-boats usually carry a crew of eight and can carry from 30 to 100 people when required.



Daily Telegraph

It is from a photograph such as this that some idea of the tremendous power of heavy seas can be gained. Here we see the *Northeastern Victory*, broken in two, as she lay helpless on the Goodwins. The vessel could not be saved, but the life-boat came to the rescue of those on board and brought them safely ashore.

MODERN CRAFT AND EQUIPMENT

Shields Evening News

It was on the River Tyne in 1789 at Newcastle that the first specially constructed vessel for saving life at sea was launched. In its thirty years this first life boat saved hundreds of lives off the rocky Northumberland coast. Many improvements in design have been made since then and this photograph shows a motor life boat being launched at Tynemouth in recent times.

Elsam, Mann & Cooper

The adaptation of radio telephony apparatus for use on the modern life boat was not a simple task, but the special designs now in use ensure that the instruments are fully protected from all risk of being rendered useless owing to damage by water. Here we see the wireless operator in the cabin of a motor life boat which is now in service.

One of the two main types of life-boat is the self-righting class. If such a vessel had a full crew on board and all the sails she carried were set, she could be turned over completely but would come the right way up and empty out all the water in about twenty-five seconds. This property was given to the boat by a heavy keel and by end-boxes, one in the bow and the other in the stern, which were really air chambers.

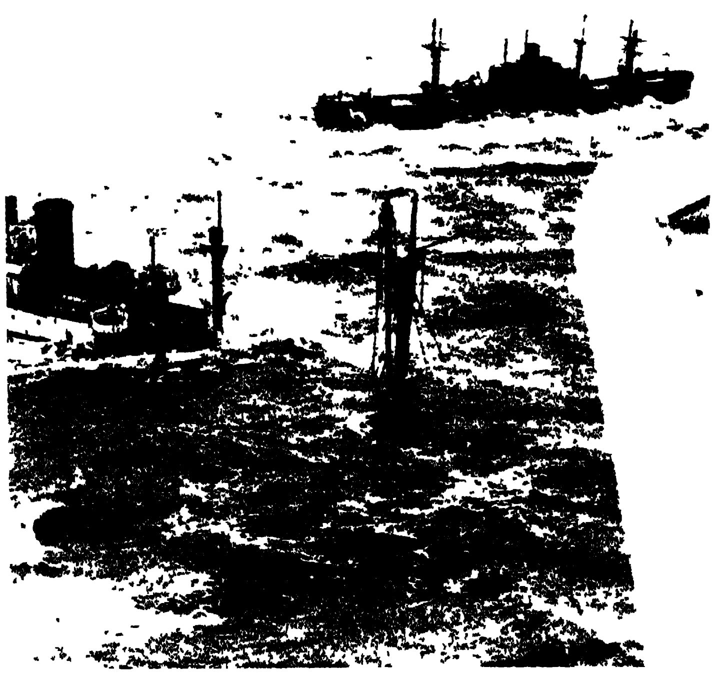
The Passing of Sails

For a time steam engines were used in some life-boats but the coming of the petrol engine provided just the right motive power for a vessel of this type, whether of the self-righter type or the non-self-righter. The latter kind of life-boat relies on her greater beam and general construction to avoid the risk of being capsized.

The first experimental motor was installed in a pulling and sailing life-boat in 1904. Now there are over 150 motor life-boats, and the last of the sailing-boats was replaced by a motor life-boat in 1948. All life-boats, small as well as large, are now being built with two engines and twin screws so that they will be entirely independent of sail, and heavy oil engines are replacing the petrol engines. This means a great increase in range of action as well as a great decrease in the risk of fire

The chief problem with all mechanical things used on a life-boat is to make them water-tight. She is a small boat that has to do her work in the worst of weather, to travel smothered in the seas, her decks awash, her cockpits filled, and it may be, if she is damaged, with her engine-room flooded. So her engine must be able to work even when it is under water. Her searchlight will go on burning even if it is dropped to the bottom of the sea. The launching tractor can drive out into the surf pounding the sea shore without fear of the water damaging the magneto or dynamo, the sparking plugs or the carburettor.

Because of this need to make every-



Graphic Photo Union

WHEN THE LIGHT OF MORNING CAME

Here is another scene of shipwreck on the Goodwins in which the life-boat had played its part before morning came to reveal the fate of the ship. On an average, eleven lives have been saved every week since the Royal National Life-boat Institution was founded in 1824

thing water-tight the most difficult invention of all to adapt to life-boat work was the wireless apparatus, obviously a highly important addition in modern times. For a long time it had to be confined to boats with cabins in which the apparatus could be fully protected from the sea. Now, however, the Service has a special design of radio-telephony sets which can be used in all life-boats without fear of damage by water. These sets also work a loud hailer; the wireless operator, by pressing a switch, can pass from talking by radio to the shore to calling direct to the wrecked vessel by means of the loud hailer.

The Royal National Life-boat Institution was founded in 1824, and since that date its fleet of life-boats with their gallant crews have been responsible for saving some 76,000 lives. This means that on an average eleven lives have been rescued from the sea every week. If you can imagine a large football crowd of 76,000 people it will give the right impression of the number of persons saved from death by shipwreck by our life-boatmen

Fine fellows are the coxswains of the life-boats. They and their crews guard 5,000 miles of our storm-swept coast. All of them are volunteers and the work is organised and financed by the Royal National Life-boat Institution. To maintain its services and carry on with the great work the Institution needs over £800,000 a year. It does not seem an extravagant amount when one considers the wonderful work which has been and will continue to be done to save those in peril on the seas around our coasts.

J H Cleet

THE MAN IN THE CABIN

The equipment fitted to the latest motor life-boats varies according to the particular type of craft. In this picture we see the man under the canopy of the cabin where he is able to communicate by wireless with those on shore or, by pressing a switch, can pass from radio to the loud hailer and so call direct to the wrecked vessel.

WITH THE FISHING FLEETS

Fox Photos

THE DRIFTERS MAKE FOR PORT

Sturdy little vessels are the Scottish drifters seen above They have been at sea a full week in search of the herring harvest and are now making as fast as their engines can drive them for Great Yarmouth This is the chief herring centre, where girls from Scotland gather in the late summer to give deft and willing aid in the cleaning and packing of the fish.

AMONG the most resolute, fearless and also enterprising of our British seagoing fraternity are the brave men who go forth in the least sizeable of vessels to catch for us our harvest of fish, the flesh of which forms such a welcome part of our daily diet Year in and year out, by day and night, through storm, icy cold or paralysing fog they carry on their hazardous work whilst we ashore accept the good food brought to us often without knowing the first thing about the stern routine of fishing for a living.

The Master Fisherman

Let us therefore consider some of the main aspects of deep sea fishing, never imagining for a moment that any fleet sets sail and casts its nets haphazardly. Such a simple plan as this would bring nothing but disaster, for fish are found only where the water is of the right depth, where the sea bed is suitable to their habits and where their natural food is abundant. Moreover, fish visit certain well defined parts of the sea at particular times of year and where there is first-class fishing say in September there may be nothing worth the catching in April These are a few of the lessons every master fisherman must learn, quite apart from navigation, seamanship and the lore of the tides and weather. He has, indeed, to know his fishing grounds as you know the way between home and school.

Has it ever struck you how much the sea, despite its uniformly level surface, is in a fishery sense to be compared to the land? You can think of high rolling downs where the soil is so thin and the herbage so scanty that there is scarcely any food for the creatures of the earth. In the sea, there are cavernous hollows corresponding to the hills. No light reaches deep water, there is no plant life upon which the fish can feed and consequently no fishing.

Thus, our fisherman has a chart

Fox Photos

SEINE-NET FISHING

From many a port round our coasts fisher men set forth by day or night to make catches with their nets Above, the Seine-net is being cleared of its herrings

which shows him where there are fathomless holes, the position of sand-banks, the set of the tides, the location of a rocky sea bed that would rip his nets, and all such matters. The chart is his map of fishing territory, but whether there are fish or not depends upon the season, perhaps on the moon and winds and to some extent on chance or luck. You may be a fresh-water angler and, if this is so, will have discovered already that the luck of the sport is almost proverbial.

Plant Life in the Sea

You may wonder, possibly, at the reference made above to plant life, but this was no mistake. The surface of the sea and the water for several feet down is literally alive with tiny growths, some like miniature plants and others in the nature of microscopic animals. Many of the little objects you could not see at all with the naked eye, and there would be added to your difficulty in this respect the fact that some of them are quite transparent.

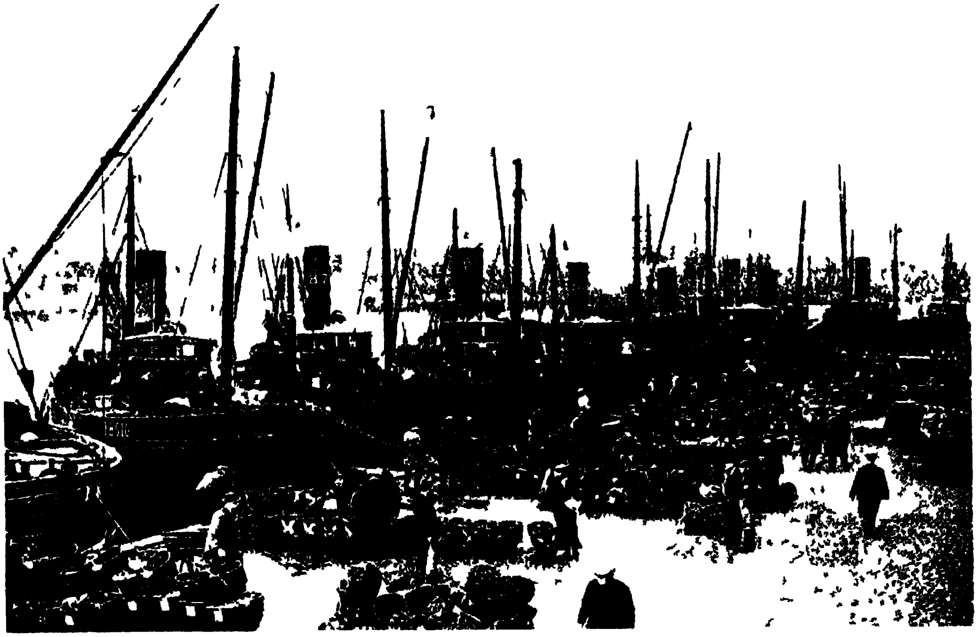
The term for this layer, which floats and drifts about, is plankton. Most of the particles are just carried along in the water, but some of them possess the power of movement. The vegetable plankton (the word means merely something that drifts) is more plentiful as a rule than the animal sort, but the latter include diatoms, copepods (sometimes called water fleas, though they are not fleas at all) and flagellates, which can swim. Plankton is the material that in some way or other brings food and nourishment to all the creatures of the sea and there is mingled with it eggs and spores to produce further generations and the very small fry of fish as well; fry, as you know, being the word we use to denote baby fishes that have just been spawned Among the plankton too we might find curious worms, wee shell fish and other strange forms of life, for the entire mass is very much alive, drawing its sustenance largely from salts and matter in the water around it

Fox Photos.

ON THE SLAB

This fishmonger has been to market early and bought his stock for the day Now he is arranging the fish temptingly for customers, perhaps without thought of the men who travel the seas to get his wares

THE FISH-QUAY AT GREAT YARMOUTH



Topical Press

The picture above gives us a splendid idea of the busy scene when a fleet of drifters has just come into port. Note how closely the little vessels are packed together

Fox Photos

Here we are able to advance to another stage in the animated scene when a fishing fleet arrives from the open sea. In this picture the catches are being put ashore

Fox Photos.

MENDING THEIR NETS

After every expedition there are sure to be some casualties in the nets. The two lads above are a fisherman's sons, and the repair of damage to their father's nets presents no difficulty to them.

Very likely you have often wondered upon what fish feed, but you will know now that plankton is the basic food of the fish world, what may be termed the lowest link in the food chain. Large fish may not take much plankton but live mainly on small fish (perhaps even the young of their own kind), but the small fish will be plankton-fed. Strangely enough, some of the very biggest sea creatures derive their living solely from plankton, sieving it against plates from the great stream of water they pass into their mouths and then through the slits of their gills.

Now it often happens that there is more plankton in a particular part of the sea at one season of the year than another. Where there is a great abundance we can carry the comparison between sea and shore one stage farther and say that a rich pasture land has been formed for the floating population. Thus, the fish concentrate in the region of this pasture and there the knowing fisherman goes to catch them. Indeed, on many fishing craft, appliances are carried with which samples of surface water are taken so that the plankton it contains can be examined, largely because certain fish will avoid particular types of plankton and be attracted to others.

Though the most fascinating of fishermen are those who go far out to sea in drifters and trawlers, clever craftsmen about whom we shall read later, we must not forget the ones who carry on very valuable work much nearer to the shore. They are known as inshore fishermen and ply their calling, chiefly by night, from at least a hundred ports all round our coasts, mostly in motor-propelled boats. At certain times they may make use of driftnets, but you will find them working mainly with strong lines, every line furnished with about 800 hooks. The hooks are not attached directly to the line, but each is fastened at the end of a short length known as a snood secured at regular intervals to the line.

How Women Help

The hooks are baited with mussels and there may be three fishermen to one boat and as many as six lines, each tied end to end. Very often the women bait the lines, which are built up in neat handy coils so that they can be shot deftly into the sea without becoming tangled or fouling the boat's gear.

The station one of these fishing boats takes up on the sea is known as its berth and there are buoys made of canvas to keep the lines, each some hundreds of yards in length, at the correct depth, and an anchor to hold the end fast. Once the lines are shot the boat is kept just moving facing the tide; and, when about a couple of hours have passed, slowly enough one may be sure to the waiting men tossed about perhaps on a restless sea, the buoy and anchor are found and the work of hauling in begins.

It is hard toil indeed, especially when some part of the line fouls an unseen ledge of rock, but there is all the excitement that goes with every type of

fishing. Though extremely unlikely, there may be a fish on every hook, but quite possibly only one hook in a dozen will hold a cod, a haddock or some other captive, the creatures being taken from the hooks as the line is carefully re-coiled. Then, as soon as the lines are inboard, the boat sets off for its harbour and there is deliciously fresh fish available in the market—or it may be sold on the beach exactly as landed.

Though this line-fishing fills in much of the time of an inshore crew they also at favourable seasons catch flat fish with what is known as a seine. This is really a wide net with long ropes at either end. The net is set with the aid of boats, and the ropes or warps may then be drawn in by men on the beach. You have perhaps watched this sort of fishing during summer holidays at the seaside, when the net becomes smaller and smaller as it is drawn in. Sometimes there is a bag made of netti. g at the rear of the net and when its mouth is drawn over the sea bed flat fish are swept into it. Seine fishing is carried out by fishing boats, much the same methods being followed as when the net is dragged in to the beach.

From our inshore fishermen we should proceed to those who form the crews of trawlers, these ships being propelled by steam. The newer vessels will travel at 16 knots (a knot is a sea mile of 6,080 feet) and may carry more than a score of hands. The crews are away from their home ports sometimes

Fox Photos

THE HARVEST OF THE SEAS

If you were to visit a fish dock in the very early morning you might come upon just such a scene as the one depicted above. The photograph was taken at St. Andrew's Dock, Hull, and you see exactly how the fish are arranged for the buyers who make purchases for markets all over the country. The man in the centre is holding up a monster halibut which is brown on the upper side.

Fox Photos

PACKING OYSTERS FOR MARKET

This picture comes from the famous Royal Whitstable Oyster Beds and we see two experienced men packing the shell-fish just as they have been dredged up at this Kentish seaport.

for three weeks at a stretch, and it is because of the trawlers' speed and the ice carried that they can get their catches home in good condition for market, some of the larger ships bringing in 200 tons at a time if they have been fortunate.

What is the purpose of trawling? It is, briefly, to draw a bag-shaped net by means of a fishing vessel so that it sweeps along the bed of the sea. The mouth of the net is kept in an extended position by heavy frames of wood filled in with spars like slats. These wooden parts are fixed by wire hawsers some distance from the trawl mouth. Beyond them come two stout ropes known as warps secured to the vessel, one forrard and the other aft. It is only because steam winches are available that this large otter trawl can be used at all. In the days of sailing trawlers and man power only a comparatively small beam trawl was feasible.

Even now, on the most up-to-date trawlers, with echo-sounding apparatus to tell the depth of water beneath the ship and all such modern gear, it is an exacting task to get the trawl net into the water, and in the correct position. Thus, when the net has been favourably cast, the ship steams slowly forward, it may be for a couple of hours. At the end of that time, a signal is given, machinery gets to work and the trawl is dragged in, the upper part of the net being hauled well up the foremast so that what is known as the cod end has its mouth immediately over the deck just in front of the bridge.

Stowing the Catch

Another moment and we might see a deck hand untie this cod end so that a perfect cascade of fish (if the cast has proved a lucky one) comes tumbling to the deck plates so much all-alive that the flapping of tails and jumping movements tell only of living fish. There may be cod, haddocks and flatfish, and very likely other denizens of the deep for which no market is available so that they must be flung overboard to the delight of the flock of noisy gulls that has been wheeling overhead. Then, at another order, outwards goes the trawl again for a further spell of duty.

In the meantime, the fish just caught must be packed in ice in the thick wooden boxes you will so often have seen and stored away in the hold. For perhaps seven days, provided the weather is propitious, this trawling will continue, according to the size of the catches. In due time, when the hold is full, back will go the trawler to her home port, piling on every ounce of speed in her haste to catch the market. In all probability the vessel will be at sea again within twenty-four hours, for there is little rest for trawler crews at the height of the fishing season.

We have fishing fleets at Milford Haven, Aberdeen, Fleetwood, North Shields, Cardiff and other places, whilst there are groups of hardy fisher folk at almost all our ports and harbours Hull and Grimsby are, however, the great centres of the steam trawling industry, and their well-found craft scour not only the North Sea but the waters of the White Sea and Arctic Ocean, their efforts taking them to the Faroe Islands and to Iceland It should be noted, however, that foreign fishermen are not allowed to operate within a three-mile limit of a country's coasts.

We will consider next the romantic story of the herring, one of the fish that lives almost entirely on plankton. It is called a migrant because it moves from place to place in the different seasons Thus, it approaches our shores from the direction of the Atlantic and may be found off Scotland during the months of summer. As autumn draws on, Yarmouth is the chief herring centre, girls travelling down from Scotland to handle the huge catches, deftly cleaning the fish and packing them in barrels for export.

Because herrings in almost untold numbers move from one part of the sea to another, the fishing fleet follows them, the vessels being for the most part steam or motor - propelled drifters which still find a small sail most helpful in their work What is called a driftnet is some 40 yards in length and at least 30 feet deep. A single drifter may have upwards of a hundred of these nets which hang in the water just like so many curtains supported at the top by buoys and cork floats, with the upper edge of the net nearly 20 feet below the water surface The nets are fastened together at their top and bottom corners to form a continuous line.

Let us understand that herrings are not caught in the bag of a net, as other fish are captured in a trawl net Driftnet work is carried out at night when the fish rise from the sea bed, partly because plankton is then nearer to the surface Each opening or mesh in the net is diamond-shaped, its sides about 1 inch in length, and what happens is that the fish are actually caught in the meshes.

Gleaming, Silvery Herrings

When morning comes, the winches clank and clatter and the nets are hauled in one after another, silvered with gleaming, glittering fish If the catch is a good one, the fishermen have merely to tauten the net and shake it, when the herrings fall to the deck In favourable circumstances a drifter may take 10,000 fish at a time, or over twenty times that number if fortune is exceptionally kind. The measure of capacity for herrings is a basket or

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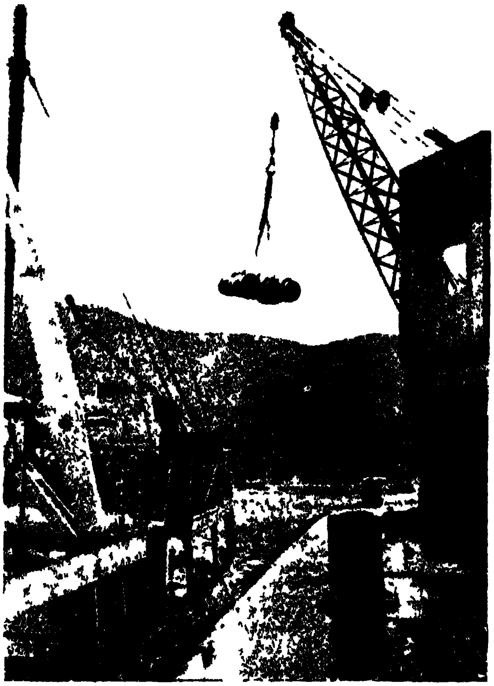
PACKING HERRINGS AT THE QUAYSIDE

From ports all round our long coastline the fishing fleets go out, and their catches are packed at the quayside Here we see the fisher girls at Mallaig packing herrings in barrels



P. Thornton

SHIPPING HERRINGS AT MALLAIG

By rail and by sea the barrels of herrings are taken from the ports to the distribution centres. Here we see the barrels of herrings being shipped at the Scottish port of Mallaig.

cran, which usually holds some 750 fish.

Strangely enough, the best fishing grounds are sometimes found completely empty of herrings and no one can say for certain where the finest harvests of this wayward fish will be gathered. When salted and partly dried a herring becomes a bloater, and it is a kipper if smoked. A member of the same family as the sprat and pilchard, the herring is one of the most valuable of our food fish, and enormous quantities are exported to other countries.

There is a lot more that could be told about our fisher folk. In the time of your grandparents there were parts of the countryside where the people scarcely ever saw fish at table from one year's end to another, unless it was cured or tinned. This is all changed in these days of motors and other speedy transport, and there are very few homes indeed where fresh salt-water fish is not available two or three times a week.

How is this brought about ? Let us imagine we are standing on the fish-quay, say at Grimsby. It is bitterly cold, being scarcely four o'clock in the morning, but a trawler fleet came in on the midnight tide and the men we see moving about in the darkness are the crews of these vessels, their task being to bring the fish from the holds and dump them on the quay.

Thereupon experts known as packers come along and divide up the fish according to their individual sizes. Very large specimens may be set in piles and others placed with ice in boxes. Long before the workaday world has had its breakfast, buyers begin to appear, looking over the fish with critical eyes. They know exactly what is needed in the markets of the country because they telephoned here and there late the previous night and now they see what fish has been brought in to meet requirements.

Presently the salesmen (representing the trawler owners) arrive and very quickly indeed the cargoes are transferred in lots to buyers, who label what they purchase. Meanwhile, on sidings near the fish docks, special trains are being loaded, or else long refrigerator vans to be attached to passenger expresses. Everything is carried out in orderly haste and soon this consignment of precious fish, the harvest of far-off seas, will be on its way as rapidly as it can be carried to markets and wholesalers from one end of the land to the other.

Even the fishmongers must be astir whilst other people are still sleeping for they visit the local market or wholesalers where there will be fish of every type derived from many sources and brought together at centres like these for distribution. Meanwhile, the fleet

has probably sailed again, its crews spending little more than a few hours at a time with their loved ones at home

The Sweep Net

You will have heard how salmon ascend certain of our rivers at spawning time and even make their way past little waterfalls and rapids in the stream In some of our rivers these royal fish are caught with a sweep net One end of such a net is made fast on the shore and the other end taken out in a rowing boat, which returns in a semi-circle pretty much to the place from which it started The upper edge of the net is supported by cork floats and it is a simple matter for men in waders to start at the two ends and slowly pull in this sweep net, so securing any fish that may have been entrapped In other parts of the country wooden stakes are set up across the river and a net tightly stretched from stake to stake Here the size and shape is so arranged that the fish are caught in the meshes

Lobster pots or creels you may have seen at the seaside They are made of basketwork, and, like so many other traps, have an entry that is large and alluring from the outside, but an exit so small as to prevent the escape of a captive from inside Lobster pots vary in design in different parts of the coast, but the bait is almost invariably a tempting piece of fish A lobster pot is weighted and dropped into the sea from a boat, its position being indicated by an attached length of rope, to the upper end of which a bundle of corks is secured Crabs for market are also caught in pots

OFF TO THE FISHING GROUNDS

Lowestoft is in East Anglia and the drifters illustrated above are just setting out to sea from this port on one of their expeditions Sometimes the crews are away from home three weeks at a stretch and the larger type of vessel carries a score of hands Nor do the fishing craft lack speed for some of the bigger modern vessels can travel at 16 knots

Oysters, of course, have to be dredged from the bed on which they rest and one can see the oyster bed marked by a series of tall wooden poles. Shrimps, which form the food of many flat fish, are caught in a large net attached to a T-shaped handle by a fisherman who wades in the water and passes his net along the top crust of the wet sand. Cockles are dug from sand at low tide, whilst mussels are taken from the beds they form, often at river mouths.

To-day our fisher folk have the invaluable support of scientific research workers and naturalists. Efforts are being made all the time to find out more about the habits of fish, exactly what the creatures feed on, how they breed and why they are discovered more extensively on one fishing ground than another. It is said that some classes of fish are smaller in size and found in lesser numbers than was the case only twenty years ago. Specimens of fish are caught and marked and sometimes, when they fall again into man's hands, it is possible to say just how far they have travelled.

The demand for fish is increasing, but it cannot be said there are more fish in the sea. Many nations fish the North Sea and the harvest of these waters is not so bountiful as it once was, so that our fleets must tend to go farther and farther afield. As for maintaining the supply, we must use nets with larger meshes, return all undersized fish to their natural element and do all we can to conserve the fish population. Perhaps one day we shall breed fish on a colossal scale and thus artificially re-stock the depleted fishing grounds.

Central Press

SALMON FISHING IN SCOTLAND

That royal fish the salmon comes in from the open sea and ascends some of our rivers at spawning time, being able even to pass the weirs. It is caught by means of nets erected on stout poles in some streams and the above photograph was taken on the River Cree. In other rivers a sweep net is used.

THE WORK OF THE DREDGER

[illegible] Dredging [illegible] Ltd

A HOUSEMAID OF LONDON'S RIVER

This is the largest type of dredger used in the Thames. She is 210 feet in length and the ladder up which the buckets pass is 28 feet high. These big vessels work day and night all the year round to scour the bed of the river and ensure a safe way to and from the Port of London for the ships of every nation. Dredgers of this type have neither paddles nor propellers.

THOUGH it cannot be claimed that dredgers are beautiful vessels, they serve a most important purpose and without them our rivers, canals, harbours, docks and other areas of water would soon be rendered useless to navigation by the accumulation of mud, sand and silt. In a sense, they are housemaids to the craft using the water, simply because they scour and clean, but their main aim is to ensure a channel sufficiently deep for the use of any ship likely to pass that way.

There are many types of dredger, for such craft must be designed and built according to the work they have to carry out. For instance, where the sea bed is composed of sand, an hydraulic suction pump system of dredging may be capable of raising many thousands of tons of matter in the course of an hour, the silt being drawn up through monster pipes. In a dock a grab dredger may be employed, the grab having jaws which open and close as it is lowered and raised by means of a powerful crane so that even corners can be cleared. To remove mud from the entrance to a dock a ... jet of water may be directed to the deposit, to stir it up so that the current can carry it down stream. Dipper dredgers belong to yet another group, performing their work with huge scoops.

In this country, though the dredgers mostly in use are of the bucket and ladder type, and such appliances can perhaps best be seen at their unending task of scouring the bed of Old Father Thames. Here, they are owned and directed by the Port of London Authority, which controls London's river, dredging from the Nore light-ship to Teddington, a distance of 69 miles.

Now just suppose the P L A has kindly given us permission to go aboard one of the big Thames dredgers and find out for ourselves exactly how

it works. The prospect is full of interest if not of adventure and we must wear our oldest clothes because dredging is a messy job especially when a choppy cross-wind sends muddy spray flying to and fro. When the time comes, our excursion will probably begin at some well-worn landing steps on the river's bank where we shall clamber aboard a steam tug.

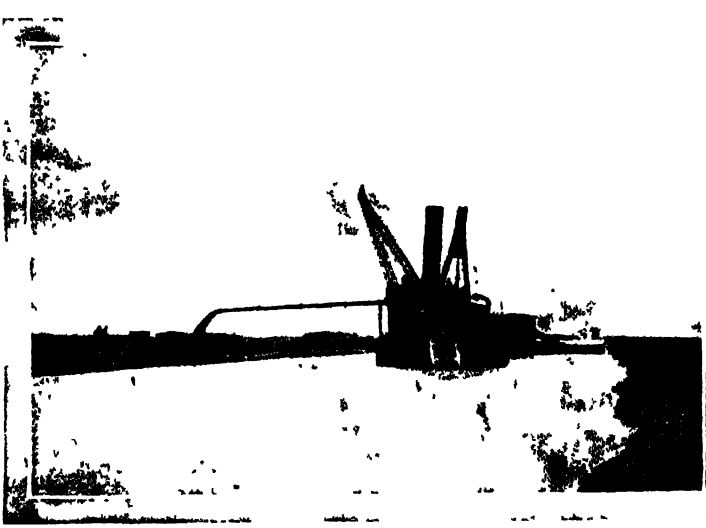
In a New World

Threading our way through the busy traffic of the stream we shall presently draw alongside the dredger and find ourselves on her steel deck in a world of clamorous din, ponderous machinery keeping up a continuous clatter. The captain, who has been expecting us, offers a cheery greeting and we are astonished when he tells us he carries a chief engineer, two mates, two second engineers, one steward, six winchmen, four deck-hands and four greasers or firemen—a crew of twenty-one in all.

Right through the week, from Monday morning till Friday evening, the dredger keeps on working by day and night, half the crew being on duty and the other half resting. Strangely enough, the men sleep soundly through all the clanking racket of ever-moving buckets and rouse only if the engines should, for some untoward reason, stop. At the week-end, three watchmen come aboard, leaving the other men free to return to their homes.

You will marvel first of all at the size of this dredger. In length she is 216 feet, her beam or width being 42 feet. From her keel to the upper edge of the deck or gunwhale she is 12 feet 6 inches; and, from the deck to the top platform of the ladder up which the buckets pass, 28 feet. If we walk to the stern we see it is rounded. Then, as we get for'ard to examine the bows, we find them different from those of any other type of ship. Thus, they are divided into two separate parts, and it may even strike you that these parts can be likened to a pair of boats, each facing the same way but with water in between.

As we are obviously a little puzzled, the captain explains that this is the well of the dredger, in which the ladder supporting the buckets is raised and lowered. He may point out that on some smaller dredgers the well is an opening right in the centre of the ship and that one can walk round it on all four sides.



By Courtesy of the Tilbury Contracting and Dredging Co. Ltd.

BOTH DREDGING AND BANK-BUILDING

The dredger here illustrated is named *Prince Farouk*. She is at work on a canal in Egypt sucking up sand and discharging it through a pipe so that it builds the canal bank afresh.

In the case of this particular dredger the bottom end of the ladder can be raised with a derrick to deck level when the ship is at rest. At present, during the working period, the ladder passes down through the well at such an angle that the lowest part is in the correct position on the river bed.

From where we

stand, we can see the buckets, one after another, emerge from the water and go clanking up the ladder, spilling liquid mud all the while You, who have travelled so often on the London tube railways, may now be thinking of the moving staircases at stations, for there is something about the buckets and ladder very reminiscent of an escalator In the latter case, hinged wooden steps running on wheels pass up a steel slope, over the top and then down again out of sight, to reappear once more at the base of the incline

AN UP-STREAM THAMES DREDGER
This is a small bucket type of dredger as used on canals and narrow rivers The Port of London Authority controls the Thames from the Nore to Teddington and uses such a dredger in the higher reaches

This is pretty much what occurs to the buckets of a dredger, but there are no other buckets quite like them and the word is really inadequate To begin with, they have flat backs and rounded fronts with a top like the broadened lip of a jug, bevelled after the manner of a chisel and made of one of the toughest metals known, manganese steel Cast-steel forms the back of the buckets, whilst the body consists of armour plates riveted round a sturdy framework. The skipper tells us that each of these buckets brings up a load of one ton and an eighth, and that an empty receptacle weighs 2 tons 3 hundredweight As it requires forty-two of these buckets to complete the chain, one is not surprised to hear that the ladder, gear and buckets weigh 276 tons The massive links which couple the buckets together would each tip the scales at 7½ hundredweight, and even the pins securing the buckets to the links weigh 96 pounds apiece.

A Floating Giant

With these figures in our minds, we decide at once that the dredger is a veritable giant and it may have struck you during our brief first inspection that she possesses neither propeller nor paddle wheels Very likely you wonder how the vessel can move at all without any of the usual means of driving herself through the water, but the dredger-master has anticipated this question for he takes us to a good vantage point and explains how so massive a vessel is kept under control and made to do her work

In this way we learn that in the water ahead, holding fast to the river bed, is a 3-ton anchor with another of the same bulk astern These two anchors are connected with the dredger by 600 fathoms (a fathom is 6 feet, you know) of 2-inch chain and 1,000 feet of thick steel cable In addition, there are four smaller anchors, two on either side, to which the ship is secured with chains and cables

It is next described to us how the vessel is moved by means of these anchors Thus, the winchmen haul on one set of chains and cables and slacken off the hold on corresponding hawsers

on the opposite side. This makes sideways movement or traversing possible whilst the ship can go ahead by hauling on the forward anchor and letting go from the stern anchor. When no further forward movement is possible by this method, an attendant tug comes along and shifts the set of anchors to new positions. Once in about two years, when the dredger requires overhaul and painting, she must be towed into dry dock.

Marine Surveyors

If you have ever thought at all about a dredger you may have formed an opinion that so long as a deep channel is cut in mid-stream all will be well. Such a plan, however, would not be satisfactory simply because the bed of a river is seldom level. Round the inner side of a sharp bend the bed is cut deeply by rushing, swirling waters; but, on the outer or opposite curve, mud and sand may be silted up to form a considerable bank.

What actually takes place is that marine surveyors come along, make frequent soundings to discover the depth of water and then prepare a chart, drawn in the form of oblong spaces, and such a chart becomes the sailing orders of the dredger-master. With the lips of his buckets he makes a perfectly straight cut 6 feet across from one bank to the other bank. The dredger is moved forward 6 feet and the next cut is made in the opposite direction. When instructions have been carried out, surveyors appear again to check the work by further soundings. As for the dredger's position in the river, the captain fixes this to within a foot or two by using his sextant, just as though he were at sea, sighting his instrument on prominent buildings instead of on the sun.

In the Chart Room

By this time we have been taken to the chart room so that we may the better understand this phase of the task, and are shown the working chart spread out upon the table. Now, as the captain is busy, the chief engineer takes us over, giving each of us a lump of cotton waste with which to wipe our hands because we are going where even the rails may be oily. Like so many seafaring engineers, our new friend is a broad Scot and a man of few words, but he makes our trip below extremely fascinating all the same.

In this way we discover that the big dredger possesses an ordinary triple-expansion marine engine with two main boilers and half a dozen furnaces capable between them of using 15 hundredweight of coal in an hour's working. Here, however, the motive power is not coupled to a propeller shaft or to the cranks of a paddle shaft but is applied by means of gearing to the very top of the ladder, 40 feet above water level. There is one short shaft in a horizontal position and then an upright shaft, like a stout steel pillar. When this pillar revolves it turns a tumbler at the top of the ladder and the endless chain of buckets is set in motion.

From the Depths

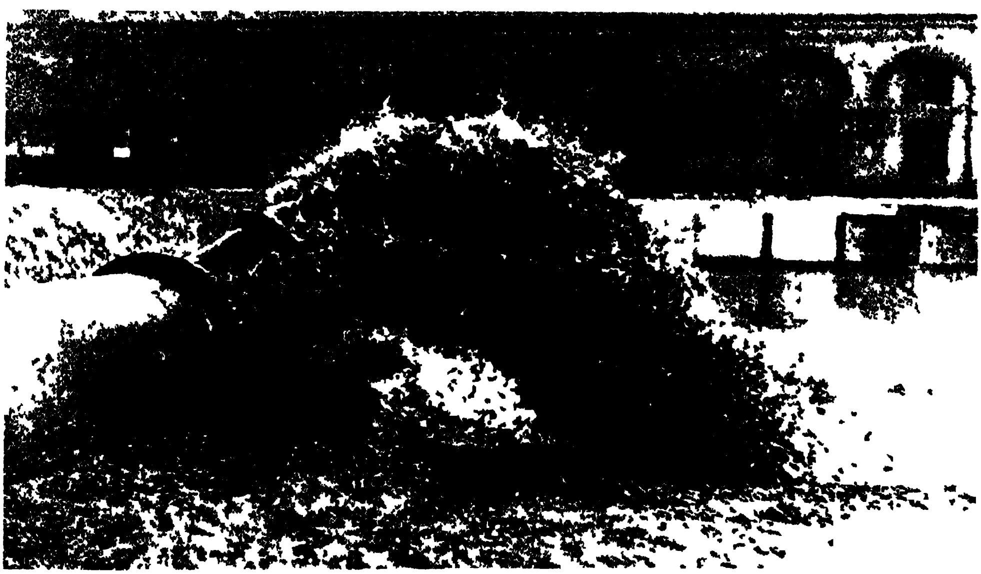
We thank the engineer at this stage and proceed to the deck, walking forward until we are standing abaft the well. A dripping, slopping bucket is just emerging from the water and we watch its passage up the ladder. Then, at the top, it meets the 9-ton manganese steel tumbler to be turned completely upside down so that its watery contents are caught by a shoot and go slithering down, splashing into the hold of a barge that is tied alongside.

A deck-hand is on duty beside us, watching to see there is nothing untoward to hinder the work or anything unusual coming up in the buckets. He is grizzled and weather-beaten and tells us that strange things are sometimes dredged from the depths. In his experience, he has seen lost anchors brought to the surface hooked in the

A GUN FROM A GALLEON

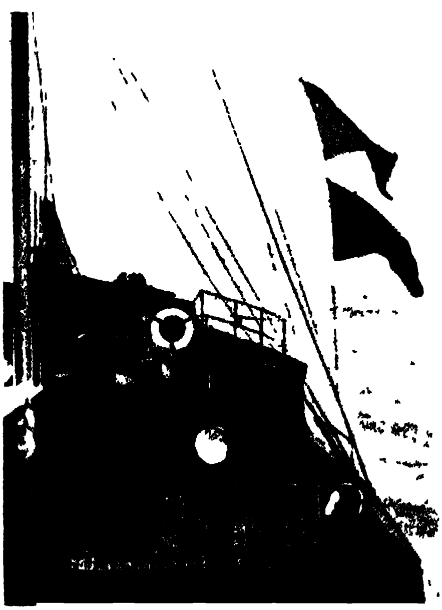
Fox Photos

Many and strange are the objects brought to the surface by dredgers. Anchors lost from ships are sometimes raised by the buckets and the old gun seen above, which may have come from a galleon of other days, was recovered from the bed of the Thames. Fragments of wreckage are often found.



By Courtesy of the Tilbury Contracting and Dredging Co., Ltd.

Suction dredgers operate on quite a different system from those equipped with buckets. They are in effect enormous hydraulic pumps and when working on a sandy sea bed can raise thousands of tons in a short while. Above is a discharge pipe from one of these dredgers sending out 500 tons of matter an hour. An old dock is being filled in and an adjacent dock deepened in one operation.



F. C. Ivory.

THE ALL-CLEAR SIGNAL

The steam hopper seen above has dumped her cargo of dredgings out in the North Sea. The flags are a signal to a light-ship that the load has been disposed of.

buckets, old guns from the days of galleons, fragments of wreckage, often from the ships of long ago, and similar bits of jetsam.

How deeply does a dredger work? It is possible for this big vessel to break up the river bed, even if it be rock, at 55 feet below water level. Seldom, however, is a ladder in the Thames set at 50 feet and more usually the depth is 30 feet or thereabouts with a bed of chalk, gravel or mud below.

A Staff of Servants

Now we walk astern, keeping out of the way of muddy, flying spray from the ladder-top and shoot, so far as we can, wondering what becomes of all the material dredged up. Here the captain joins us again to say that his ship can raise 60,000 tons of the silt in the course of a week's work.

We hear next that the dredger has its own staff of servants, no fewer than nine of them. Four of these attendants are 2,000 ton "dumb" hopper barges, which have no motive power and so must be towed; three steam hoppers, each of about 750 tons; and a couple of steam tugs.

Thus, so long as the buckets are working, there must always be a hopper alongside the shoot, the barge being filled until its hold is solid with mud and all the water possible has poured over the side and made its way back to the river.

To the Black Deeps

We find that one dumb hopper can be filled every three hours and that such a vessel carries a crew of eight, who live on board all through the week. As for the disposal of the dredgings, we learn of a bottomless pit away out in the North Sea, fifty miles from Thamesmouth, a place known as Black Deeps Here the scourings of the river are taken, the barges having along their bottoms fittings like enormous hinged doors which can be opened downwards, releasing the cargo and allowing water to come swirling in to wash the grimy plates. The hopper does not sink because of watertight compartments and there are chains and a steam donkey engine for the closing of the underwater shutters when required.

A dirty job, especially now that Thames mud is charged with oil from the ships of all the nations, but yet a task that renders possible the passage of ocean-going vessels to and from our premier port. It has been an interesting and instructive trip; and, as we thank the captain and leave the dredger he tells us he has heard that the material taken from London's river in a period of twenty years would build a wall 1 foot thick and 10 feet high all round the Equator, or form a mountain at least half the height of Snowdon. On the other hand, it could be set up in twelve separate masses and each of them would be an equivalent to the Great Pyramid of Egypt.

A VISIT TO LONDON'S DOCKS

HEADQUARTERS OF THE PORT OF LONDON *P.L.A.*

London was a port before it became a city. Even before the Romans came to Britain there was sea-borne trade from the settlement on the Thames. Under the Romans the shipping developed and it has continued to expand. In 1908 all the dock companies were transferred to a new body called the Port of London Authority. Our photograph shows the head office of the P.L.A. in Trinity Square near the Thames and the Tower.

LONDON was a port before it became a great city and the capital of England. Before the Romans came the inhabitants of the south-eastern part of Britain had attained a fair standard of civilisation and carried on trade with the Continent mainly through the old south coast ports of Richborough, Lympne and two or three other little places which have long ago lost their importance.

The shortest route for those who brought the goods from the rich agricultural areas of East Anglia to these ports was by way of the ford a little below where London Bridge now stands. This ford became the focus of many trackways where traders met, and gradually a settlement was established. The name London by which this settlement came to be known springs from an old Celtic word.

When the Romans came they very quickly developed British exports to the Continent. Apart from slaves these exports included skins, hunting-dogs, corn, cattle, metal, iron, silver and even gold, and these were exchanged for ivory, amber, jewellery, glassware, pottery and household articles. The estuary of the Thames is directly opposite the mouths of the three great Continental rivers, the Elbe, Scheldt and the Rhine, and so the Roman Londinium grew in importance. Tacitus, the Roman historian, writing of it in A.D. 61 says that it "was much frequented by a number of merchants and trading vessels."

"The Mart of Many Nations"

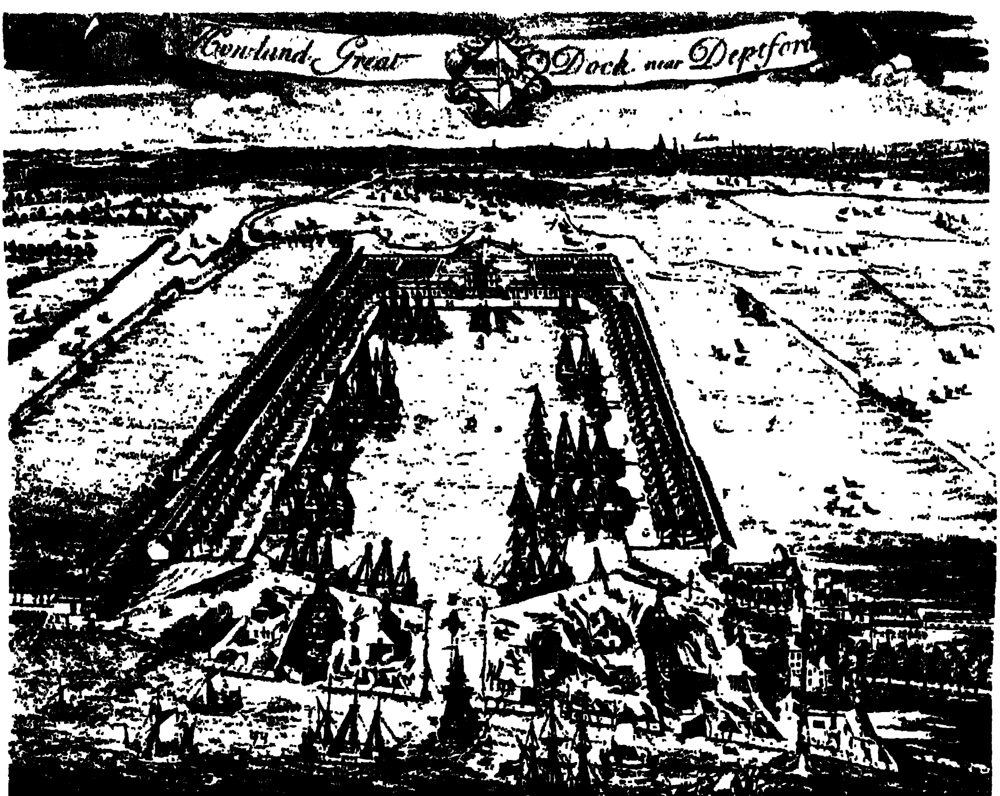
By the end of the second century London was "a great and wealthy city," and in the year A.D. 359 some 800 cargoes of grain were exported to the Roman storehouses on the Rhine. When the Romans left half-a-century or so later their departure must have

had its effect on this trade, but there are few records of its development during the next century. Yet in A.D. 604 the City had its own Bishop, and about this time the Venerable Bede speaks of London as "the metropolis of the East Saxons" and "the mart of many nations resorting to it by sea and land."

London became strongly fortified and it was sufficiently far inland to present great difficulties to the Danish invaders who harried our shores. King Alfred gave some land to Archbishop Ethelred who made a "hithe" (meaning a wharf or landing-place) which later became known as Queenhithe. Billingsgate was probably the very first "hithe" to be constructed on the river front, and there are records of the tolls charged towards the end of the tenth century in respect of vessels from Normandy, France, Liége and other Continental places.

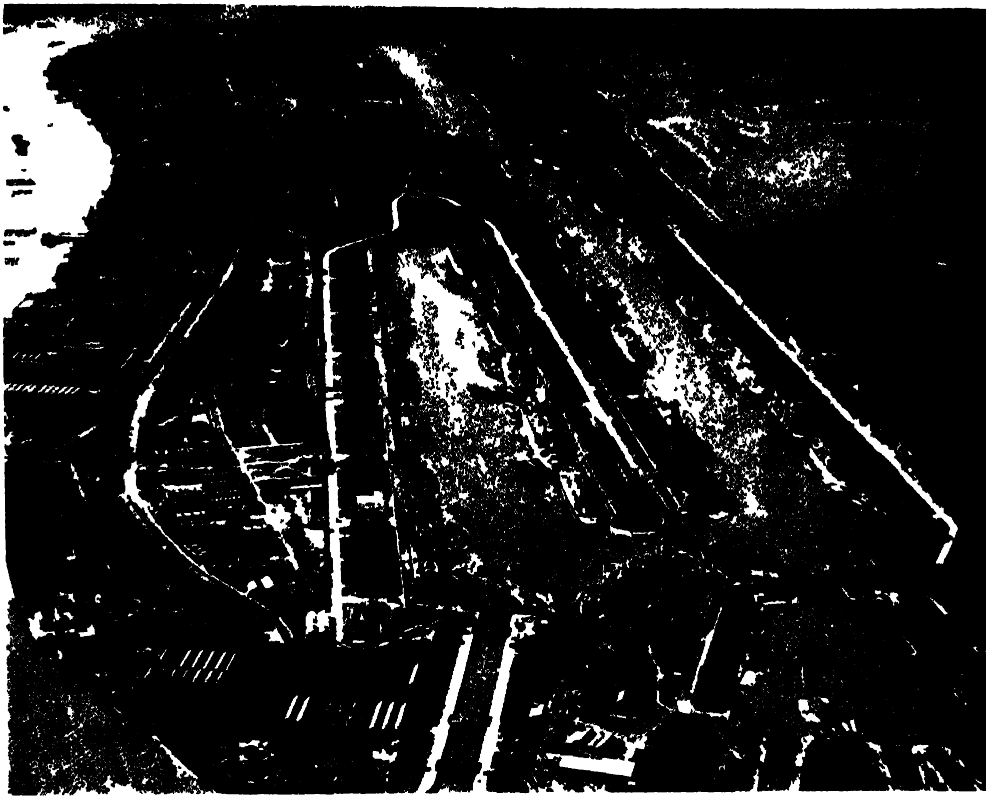
When William, the Norman Conqueror, came to London he bargained with the people and granted them their first Charter. It was during this period too, that many foreign merchants came to London from Normandy, Flanders, Italy, Spain and many other countries as they found the city "fitted for their trading and better stored with merchandise in which they were wont to traffic."

The story of the growth of the Port of London since those days is one of enterprise, romance, and high adventure. The merchants and shipowners of



ONE OF LONDON'S FIRST DOCKS

Docks as we know them to-day are a comparatively modern development. One of the first wet docks to be constructed was at Blackwall, and Samuel Pepys visited it in 1671. What was really the first of London's docks was the Howland Great Dock which could harbour 120 merchantmen when it was opened in 1700. Our photograph from an old print shows how it appeared in those days.



LONDON'S ROYAL DOCKS FROM THE AIR *Aerofilms Ltd*

The Royal Victoria Dock was opened in 1855 and was the first to be connected with the country's railway system, while the Royal Albert Dock, opened 25 years later, was the first to be equipped with electric light for night work. With King George V Dock these "Royal Docks" are the largest enclosed docks in the world, and are interconnected by waterway passages. King George V Dock is in the centre; parallel, on the right, is the Royal Albert, and at the top the Royal Victoria Dock.

London did not sit in their offices and wait for trade to come to them. They took great risks and there was no lack of fine sailors and brave adventurers willing to share those risks. You will read in Volume II of Sir Hugh Willoughby and Richard Chancellor who sailed from Deptford in 1553 to open up trade with Russia. The Russian Company, which was the outcome of this, was one of the most successful of the early maritime companies. Other Merchant Companies were formed, among them the East India Company whose first fleet sailed from Woolwich in 1601. Five vessels there were and they returned two and a half years later with over a million pounds of pepper.

An Early Link With Canada

This broke the Dutch monopoly of the spice trade and not before it was time. The price of pepper had gone up in 1599 from 3s. to 8s. a pound, and at that time there was great need for pepper and other spices to make the coarse food of most people more palatable. The East India Company quickly became soundly established after its first successful venture and the trade with India has ever since been closely associated with the Port of London. There was, too, the foundation of the Hudson's Bay Company in 1668, and the connection then formed between Canada and the Port of London has remained unbroken.

With the East India Company's trade developing, larger vessels were built. There were no docks as we know them to-day. The big ships were moored in the stream and their cargoes transferred to and from shore in small boats. The East Indiamen anchored off Blackwall, their cargoes being transferred to the legal quays in the Pool in the only covered barges used in the Port. About the middle of the seventeenth century the Company constructed a small wet dock at Blackwall for fitting out their vessels after launching from the nearby shipyards. This dock was the first on the Thames to be fitted with gates, but it was not used for handling goods. Samuel Pepys records in his diary that he went to see this dock in 1661. In due course it became part of the Brunswick Dock, which in turn was absorbed by the East India Dock of to-day.

In the year 1700 the Howland wet dock was opened at Rotherhithe on the south side of the river, about three miles below the present Tower Bridge. This was really the first of the London docks and it had room for 120 of the largest merchantmen of the day. Trees were planted round the dock as a protection against the wind and it became very popular after the great storm in 1703 which wrought havoc among the shipping moored in the river. This Howland Dock was the nucleus of the present Surrey Commercial Docks system.

River Pirates and Mud Larks

Howland Dock was intended only as a safe anchorage and had no facilities for loading and unloading cargo. For a century it was the only dock and gradually became the headquarters of the Greenland whale fishery trade; its site to-day is occupied by the Greenland Dock, part of the Surrey Commercial

NEAREST TO THE SEA *P. I. A.*

Twenty miles down the river are the Tilbury Docks and these are much nearer the open sea than any of the others. To Tilbury come many liners of the famous shipping companies and here passengers are landed and cargo is unloaded. At Tilbury, too, are two of the ten dry docks owned by the Port of London Authority, and repairs to the largest vessels can be carried out here. Our photograph shows shipping in the Centre Branch Dock at Tilbury.

Docks system. Writing of the Howland Dock in 1790, Thomas Pennant mentioned the fact that the Greenland ships discharged their cargoes here "and at this place the blubber is boiled at a fit distance from the capital." To-day London has not merely reached Rotherhithe but stretches far eastwards of it.

Some idea of the congestion that existed in the river about this time may be gathered from the fact that in the Upper Pool 1,775 vessels were allowed to moor simultaneously in a space adapted for about 545. It must be remembered that a ship of 500 tons was spoken of at this time as being of exceptional size. The position was aggravated by the large number of craft, probably about 3,500, employed to carry the cargoes from the moorings to the wharves. The extent of these wharves was wholly inadequate and goods remained for weeks at a time in lighters before they could be dealt with. They lay exposed to the weather and to the mercies of the river thieves who carried on a well-organised and highly profitable business. The several classes of thieves were known by the type of work they carried out: there were River Pirates, Night Plunderers, Light Horsemen, Heavy Horsemen and Mud Larks.

TO LIFT 150 TONS P.I.A.

The largest of all the floating cranes in the London Docks is the "London Mammoth" seen in the photograph above. It has a lifting capacity of some 150 tons and can be moved in and out of the docks to tackle whatever heavy job may be required of it.

Parliament was moved to act at last and a Bill, promoted by the West India Merchants and the Corporation of London, was passed in 1799. Two docks were built with a range of splendid five-storey warehouses. High walls and a wide ditch surrounded the premises and an armed watch of 100 men and officers, supplemented by 100 special constables, kept safe guard.

Australia's First Cargo of Meat

During the nineteenth century many

SHIPPING IN THE POOL

[illegible]

One of the busiest parts of London's river is just below Tower Bridge on the stretch of water known as the Pool of London. The headquarters of the Port of London Authority almost overlook the Pool and here may be seen shipping from every port in the world, with tugs, barges, cranes and their operators all busily employed in the big task of manoeuvring the ships or in unloading or loading cargoes.

steps were taken to increase the Port's facilities, and, as the size of vessels increased, additions were made to meet the changing circumstances. The steamship made its first appearance on the Thames in 1815, but it was not until 1875 that sail definitely took second place to steam in the tonnage of vessels using the Port.

London has played a specially important part in the commercial development of Commonwealth countries. The first exports of wool, meat, butter, cheese and other products from Australia and New Zealand were sent to London and sold on the London Market. The first consignment of frozen meat and butter from Australia arrived in the Thames in 1880. New Zealand's first meat shipment came to the Port in 1882 by the sailing ship *Dunedin*, an historic event that may be said to have laid the foundations of New Zealand's economic progress.

At this stage the docks were owned by private companies. Financial and other difficulties arose and eventually in 1908 all the docks of the Port of London were taken over by a public body named the Port of London Authority, which paid the owners some £32 millions for them. The "P.L.A.," as it is familiarly called, levies dues on all ships entering the river, and "dock rates on all ships using the docks as well as charges for any services rendered." Any profits made are used to improve conditions in the port itself.

Rather more than a century and a quarter ago the tonnage of ships entering and leaving the Port of London, which is that part of the Thames between Teddington and the Nore totalled 2½ million. In the peak year of 1937 it was over 62 million net registered tons. To accommodate the steady increase in the volume of shipping, great groups of docks have been built.

The Groups of London Docks

Starting from the Tower Bridge and working down along the north bank we come first to the St. Katharine and London Docks. A few miles eastwards are the West India Docks and Millwall Dock in the Isle of Dogs, and the East India Dock. Further down the stream we reach the "Royal" group of docks – the Royal Victoria, Royal Albert and King George V – and finally at Tilbury, which is well outside London but still in the Port of London, is the group nearest the sea.

On the south side of the Thames we find a single group, the Surrey Commercial Docks, in the bend which the river makes northwards between Rotherhithe and Deptford. These include the Greenland Dock already mentioned.

As one travels by water down the river all that one sees of the docks from near water-level are the wall-like gates of their entrances. But for the hulls, funnels and masts of great ships rising high and unexpectedly above the surrounding buildings, the presence of great sheets of still water so near the tidal waters of the Thames would never be suspected.

The docks represent a great amount of human labour and planning. A wet dock is usually formed by cutting deep trenches all round the site, building in them the massive walls which will act as quays, and then removing all the earth enclosed by the walls to the required depth—thirty or forty feet as the case may be. If all the docks of the Port of London were merged into a single sheet of water it would be more than a mile square.

But a dock is far more than a sheet of water confined by great walls of masonry or concrete. The water is merely the counterpart of the sidings of a big railway goods yard. A ship is earning money only while she is carrying cargo and it is therefore important that the operations of loading and unloading shall be made as brief as possible. So a dock must be equipped with machinery and have sheds and stores, called warehouses, for holding

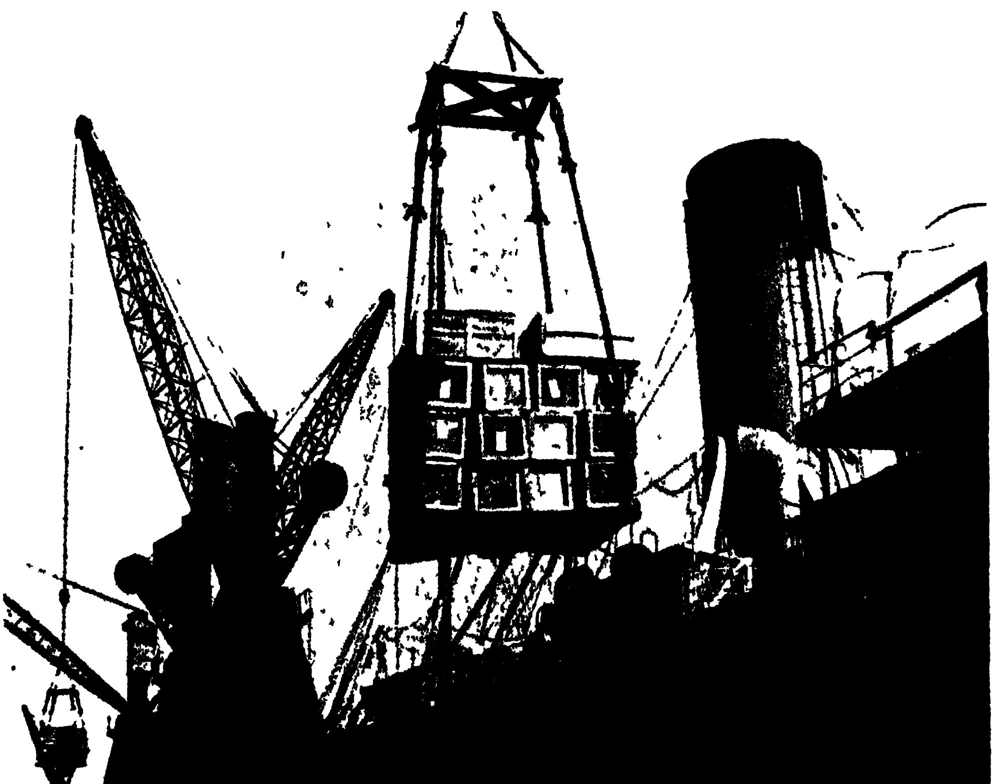
goods, as well as roads and railway tracks for moving them. Every day that a ship can save in loading or clearing out her cargo may mean hundreds and even thousands of pounds to her owners.

Our Imports and Exports

In normal times the annual value of the Port's overseas trade, exclusive of coastwise trade, was £593 millions, *i.e.* one-third of the overseas trade of the United Kingdom. The volume of goods handled each year was approximately 42 million tons. As a result of the disturbed state of post-war international trade, the latest figures show some diminution in these totals, but this drop is approximately the same as the lower trade levels in most British ports. More than a hundred shipping companies operate regular direct services from the Port of London to over 300 ports throughout the world, and more than 700 ships on regular services leave London every month.

Here are a few items out of a very large number which will give you some idea of the quantities which have to be dealt with: Cheese, 80,000 tons; eggs, 31,000 tons; spices, 11,000 tons; sugar, 832,000 tons; tea, 127,000 tons; wine, 30,000 tons; tobacco, 35,000 tons, wool, 191,000 tons; paper, 134,000 tons; rubber, 90,000 tons; frozen and chilled meat, 554,000 tons; wheat and flour, 1,323,000 tons. These are round figures for a post-war year.

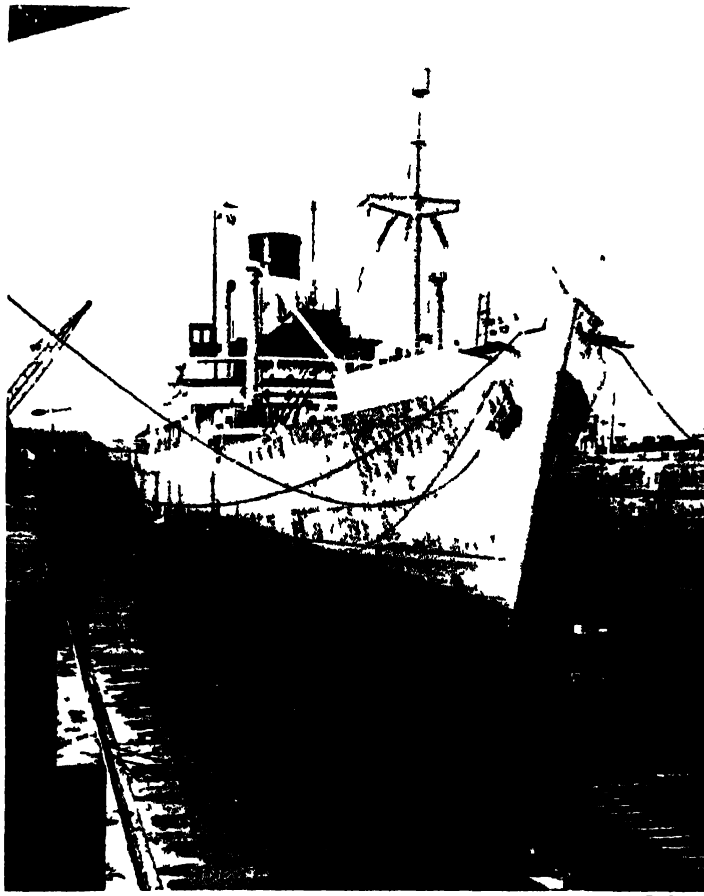
Then there are exported goods of enormous value to be put aboard the



GRAPEFRUIT FOR BRITISH TABLES *P. L. A.*

This photograph shows a cargo of 57,000 cases of grapefruit arriving in the Surrey Commercial Docks by the steamship *Corrales*. The "set" is being manœuvred into position as it is lowered to the quayside on to a waiting electric truck. Some 26,000 transport workers are directly employed in handling cargo in the Port of London.

outgoing ships These include some millions of pounds' worth of goods brought in to be exported again to other countries, for London is the great market of the world in certain commodities such as tea, rubber, wool and tobacco, collected from all parts of the globe.



IN THE DRY DOCK AT TILBURY P I A

Only by the use of dry dock can the hulls of ships be examined, repaired and paint ' This dry dock at Tilbury has the most modern equipment of any dock in the world and will accommodate the largest ocean liners In this photograph the *City of Agra* has been safely settled the water has been pumped out and the ship is ready for examination and whatever repairs to the hull may be necessary.

Passengers, Mail and Mixed Cargoes

Though all the docks are now under the one control of the London Port Authority, the various groups still specialise in certain cargoes The London Docks (which must not be confused with the docks in the London area generally) are the great wool docks Normally at the Surrey Commercial Docks more than half a million tons of sawn timber are unloaded annually, and many piles of it are always to be seen in the open or under cover A considerable amount of general cargo is also dealt with at this dock

The West India Docks are the great sugar centre, and there you may find 100,000 tons of it in store , while at the " Royal " Docks most of the frozen and chilled meat and tobacco comes ashore But some of the docks handle all sorts of commodities as they are the headquarters of different lines of steamship companies which combine passenger and mail carrying with the transport of " mixed " cargoes

Dockland is, generally speaking, not at all beautiful, but it is the centre of London's wealth, and, to anyone who loves ships and the bustle of commerce, it is full of romance and interest It is a land of curious sights Spires and masts are mixed up together Ships' funnels appear to project from the tops of buildings ; factory buildings sometimes appear to have been fitted up with spars and rigging

On reaching a dock one finds oneself blundering over railway tracks, dodging wagons and crane loads, and, as likely as not, cut off for a time by the raising of a bridge to let a vessel pass. But

any slight inconvenience is amply repaid when at last the visitor is at the quay where one of the thousand ships that pass up and down the Thames is being discharged.

To ensure the prompt discharge and loading of ships hundreds of quay cranes, fixed and mobile, of varying capacities, are provided, while for awkward and heavy lifts a fleet of floating cranes is available, the largest of which is the "London Mammoth" with a lifting capacity up to 150 tons. These, however, do only part of the work since the ships' own tackles are busy discharging or loading cargo as fast as they can. Other equipment for handling cargo includes rail shunting cranes, petrol shunting trucks for the dock railways, fork-lift and electric runabout trucks.

Besides all this apparatus many strange devices for unloading are used. Grain is sucked out of a ship's hold by great pipes with large nozzles on the end acting on the same principle as a vacuum-cleaner. Many other types of mechanical labour-aids have been introduced into the Port of London while others are being tested for their suitability on different types of work.

In the Bonded Warehouse

As the cargo leaves the ship it may be loaded straight into waiting wagons, or on to the quay, or into the " transit " sheds running parallel to the quay's edge. Once in the sheds, the goods are protected from the weather while being sorted for delivery to railway wagons or lorries which carry them away to their purchasers or to one of the many large warehouses belonging to the Port of London Authorities.

All dutiable goods, such as tea, tobacco, wines and spirits, come under the care of the Customs authorities immediately they land and go into bonded warehouses. They cannot be taken from these warehouses for sale in the country till the duty has been paid on them. While in the care of the Customs —and they may be there for a long time—experts look after the goods, carrying out various operations for the importers. For instance, the tobacco, of which there may be 40,000 to 50,000 tons "in bond," is sorted out; damaged or useless leaves are burnt in the "Queen's Pipe" which is a furnace in a small building used only for destroying condemned cargo. The tobacco is worth taking care of, as can be imagined, since the duty payable on it in these days is so enormous.

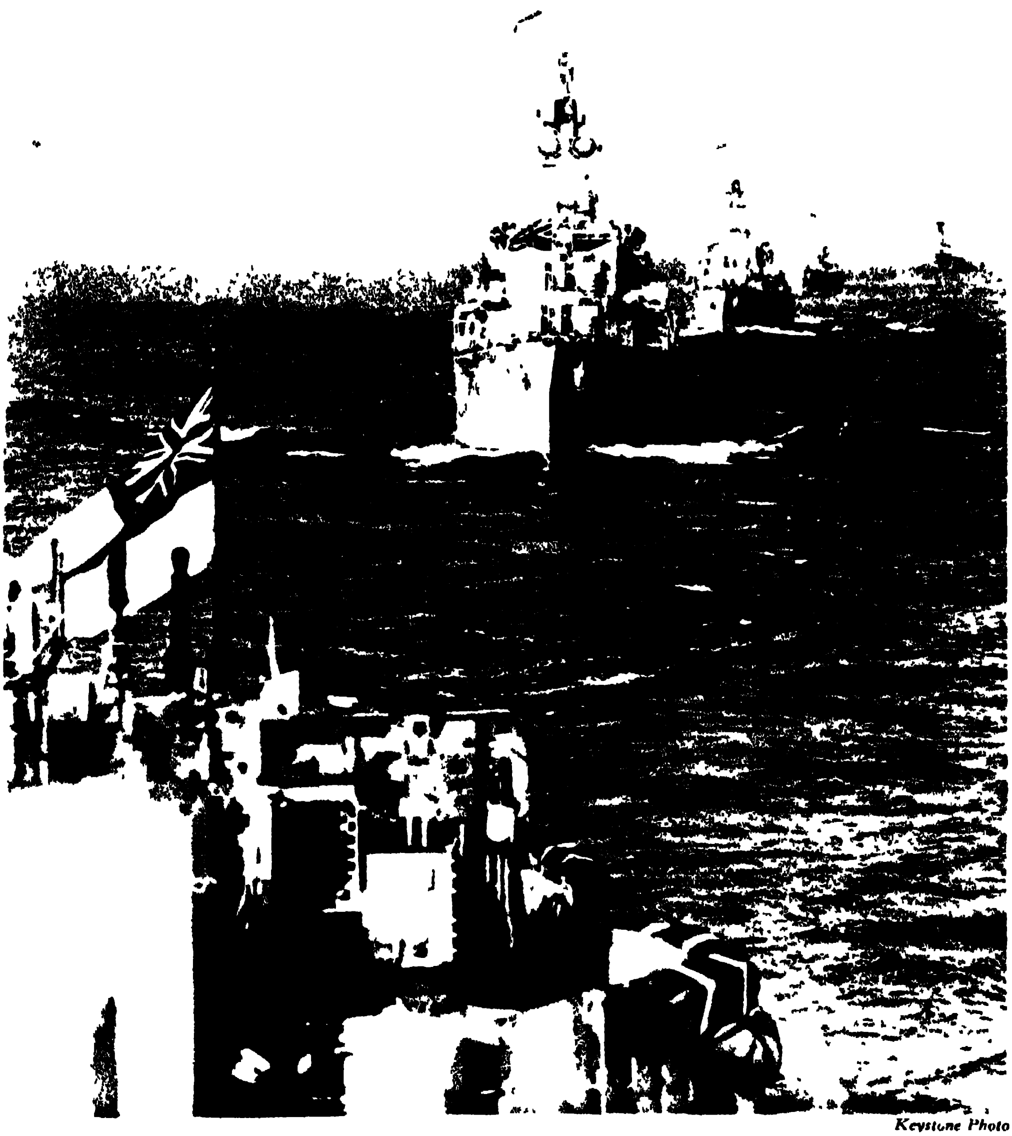
Among the Treasure Houses

A visitor to Dockland would hardly suspect how immense a quantity of valuable goods is stored within its somewhat dingy area. The rapid unloading and loading of ships makes it necessary that there should be large premises handy to the quay where goods can be stored.

Importers and exporters also find it much cheaper to hire warehouse space from the P.L.A. than to construct or rent huge buildings of their own outside the dock areas. For these two reasons there are, within easy reach of the dock quays, buildings of great size crowded with goods of all kinds, other than those liable to duty. In this area there are nearly 24 acres of floor space piled with great bales of wool—more than 10,000 tons of it usually. In another building are thousands of tons of rubber. In that gaunt pile over there is a cold store in which over a quarter of a million carcases of lamb or mutton can be kept in good condition indefinitely. Beyond this is another building given up entirely to fruit.

Possibly more interesting than these are the warehouses set apart for Oriental goods—carpets, spices, drugs, antiques, and so on. Nor must we forget the ivory warehouse, with its many tons of ivory in the tusk worth £1,500 a ton, to buy which people come from every part of the world.

GUARDIANS OF THE SEAS

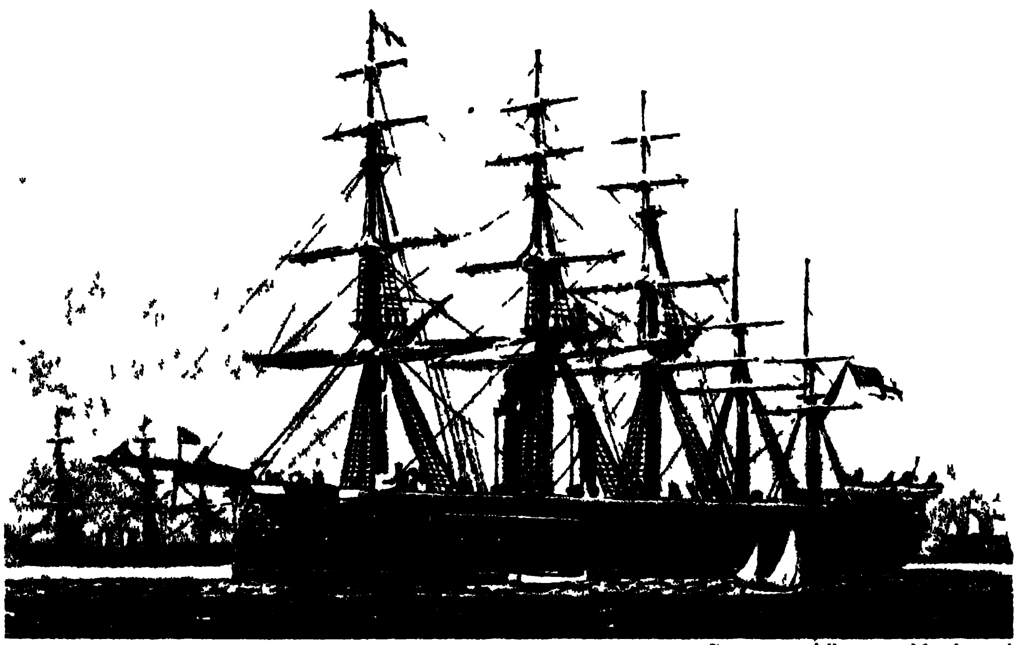


Keystone Photo

"It is upon the Navy, under the good Providence of God, that the wealth, safety and strength of the Kingdom do chiefly depend" That has been true for many centuries down to our own times, when in two World Wars attempts were made to starve this island into submission. It was the Navy which kept the seas open to our ships during those years of peril In this photograph, taken from H.M.S. *Agincourt*, can be seen *Dunkirk*, *Corunna* and *Jutland*, forming in line ahead, while in the distance *Loch Veyatie*, leader of frigate, is turning into line.

In the reign of Charles I the Royal Navy had a three-decker man-o'-war This vessel, shown above carried no fewer than 104 guns and was the finest battleship of her day

Probably no vessel in the world is better known than H M S *Victory*, Lord Nelson's flagship at Trafalgar She has been restored to her original state and is now at Portsmouth



Drawings specially prepared for this work

Commissioned in 1867, H M S *Minotaur* was one of three sister ships, the largest single-screw warships ever built, and among the very earliest ironclads of the Royal Navy The three sisters, *Minotaur*, *Agincourt* and *Northumberland* each had five masts as they could only carry 750 tons of coal, and a large spread of canvas was necessary owing to their small range of action and slowness under steam.

PORT AFTER STORMY SEAS

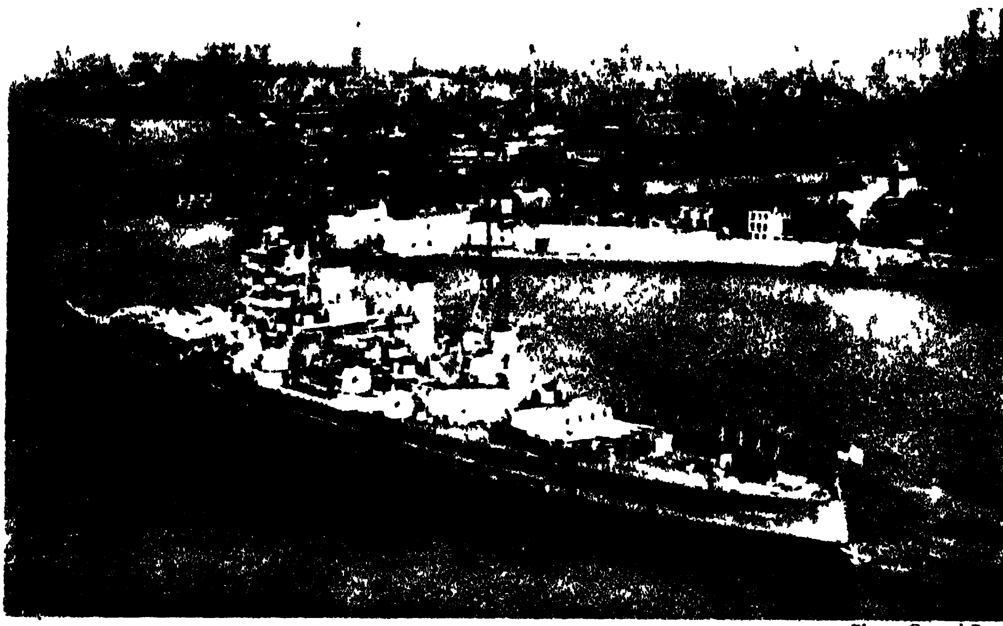


Photo Central Press

In this fine aerial photograph of the famous battleship H M S *King George V*, the crew are lining the decks in traditional manner as she sails into Portsmouth Harbour after duty at sea. During the war *King George V* sank the *Bismarck*, and later, as flagship of Vice-Admiral Rawlings in the Pacific, took part in every operation against the enemy until the end, when she was present at the final surrender of the Japanese to the Allies.

Central News

Cruisers are smaller, faster, and more lightly armed war vessels than the battleships Formerly the place of the cruisers was right ahead of the main battle-fleet, but they are now used more on important convoy work, or as squadrons in distant waters Some may be fitted with A A guns for defence of the fleet. Our picture shows one of the latest British cruisers, *Superb*, a vessel of 8,000 tons, capable of a speed of 31.5 knots

BATTLESHIP, SUBMARINE AND SPEED-BOAT

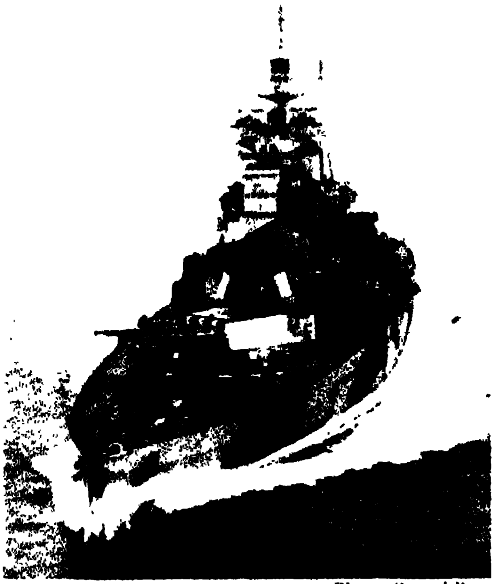
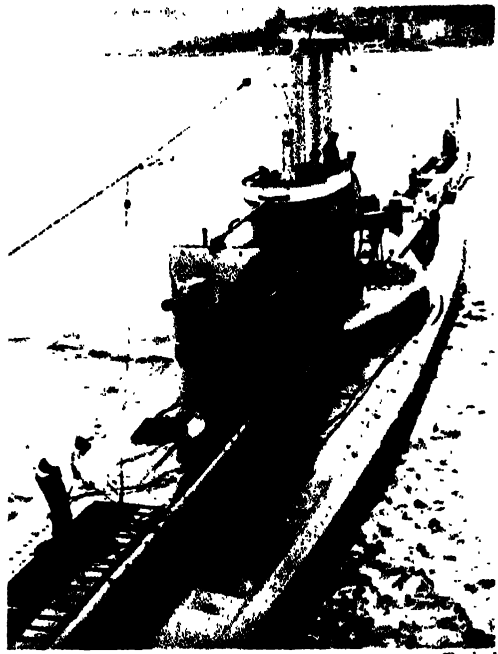


Photo: Central Press

In this photograph is seen H.M.S. *Howe* engaged on exercises. Some idea of the formidable power of such a ship is indicated by the size of the guns in the forward part of the vessel.



Topical

Here is the famous submarine *Ambush* which carried out underwater endurance tests in the Arctic seas. The vessel was fitted with a special breathing tube and the crew issued with Arctic rig.

Photo: Central Press

Revolutionary in build and design, the *Celerity* was the first vessel to be fitted with air-cooled aero-engines (Bristol Hercules XVII radial air engines) which drive variable-pitch propellers. Her superstructure and practically all her fitments are made of a light alloy. *Celerity* has a maximum speed of 40 knots, and our picture shows her travelling at speed in the Solent.

FIGHTING SHIPS OF AUSTRALIA AND CANADA

Photo Australian News and Information Bureau

The Commonwealth of Australia has its own Defence Forces Navy Army and Air Force In this photograph we have one of the ships of her Navy H M A S *Australia* a heavy cruiser In addition Australia has the aircraft carrier *Sydney* and other vessels as well as a reserve fleet The magnificent qualities of Australian forces made them famous in two world wars

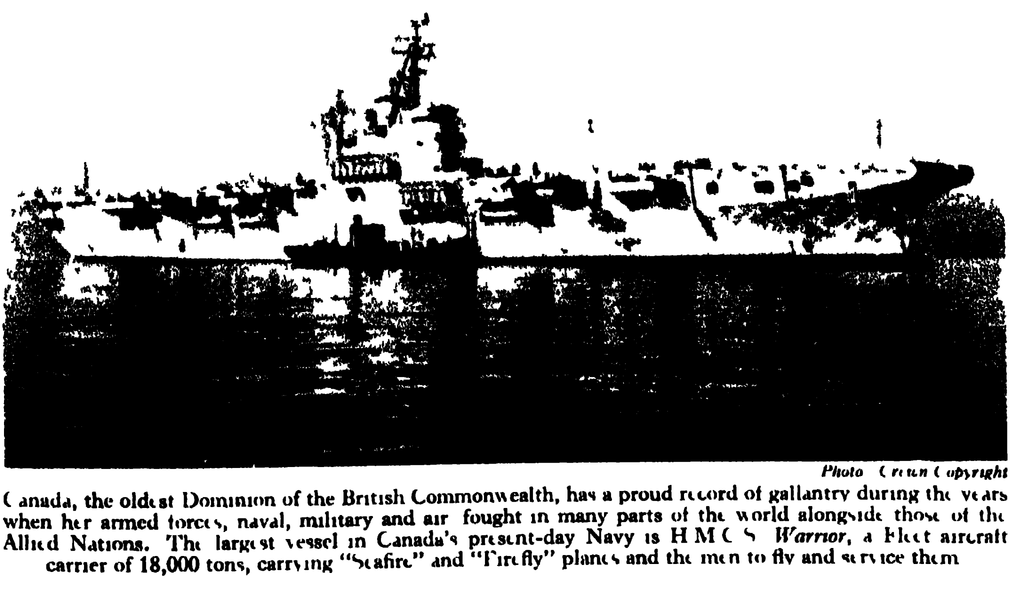


Photo Crown Copyright

Canada, the oldest Dominion of the British Commonwealth, has a proud record of gallantry during the years when her armed forces, naval, military and air fought in many parts of the world alongside those of the Allied Nations. The largest vessel in Canada's present-day Navy is H M C S *Warrior*, a Fleet aircraft carrier of 18,000 tons, carrying "Seafire" and "Firefly" planes and the men to fly and service them

MODERN DESTROYER AND CRUISER

Photo Central Press

Two of the Royal Navy's latest and most powerful destroyers are the *Crossbow* and *Battleaxe*, which in many aspects are regarded as the most modern fighting ships afloat today. Destroyers, which is an abbreviation of their earlier name of torpedo-boat destroyers, were first designed in 1893, and have played an important part in naval warfare during this present century. Our photograph shows H.M.S. *Crossbow* taken while at sea.

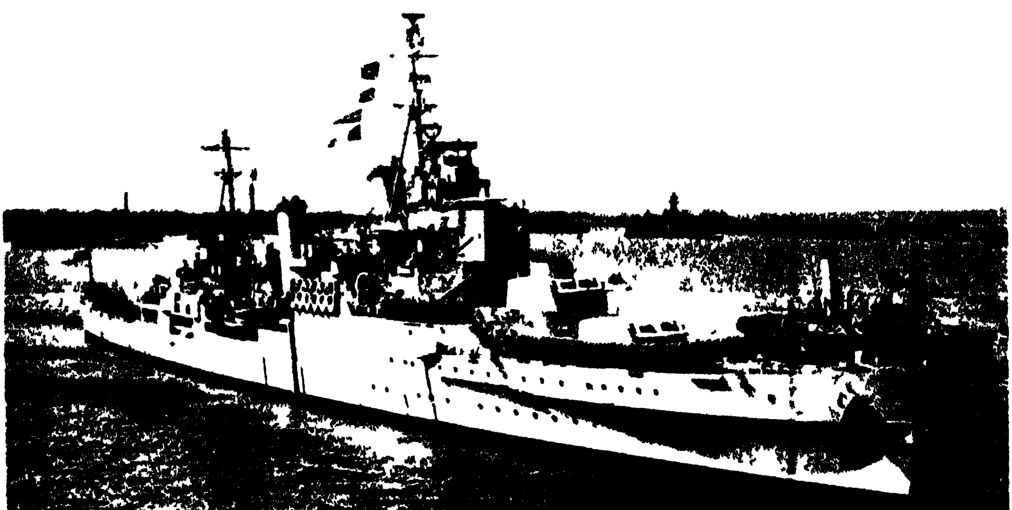


Photo P. A. Reuter

Here we have a view of H.M.S. *Glasgow*, a famous cruiser of the "Southampton" class, returning after two years' service on an overseas station. The photograph was taken as she steamed into Portsmouth Harbour at the end of her voyage with her crew on deck. *Glasgow* was completed shortly before the 1939–45 war, and was on active service throughout those years.

ALL AT FULL SPEED AHEAD

Photo Central Press

Motor torpedo boats (M.T.B.) of the Light Coastal Forces carried out amazing exploits in war time. In this picture an M.T.B. of the 71 ft. 6 in. type is seen at speed in heavy weather

Photo Charles E. Brown

Next in size to the battleships and aircraft carriers of the Navy come the cruisers. Our photograph shows one of the County class cruisers, H.M.S. *Devonshire*, now used as a Cadet Training Ship

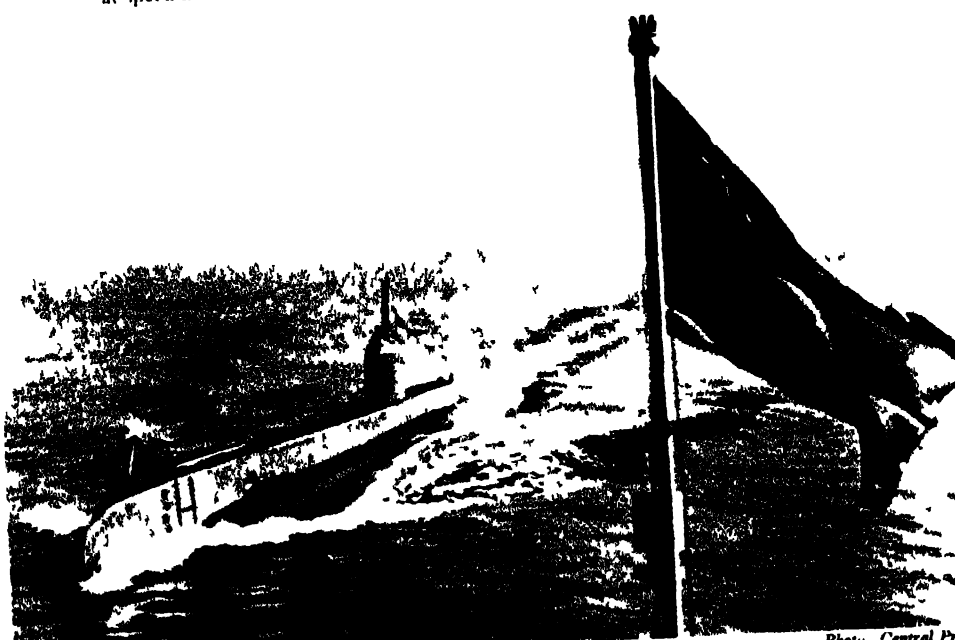


Photo Central Press

Although underwater craft had been used experimentally before this century began, it was not until 1901 that the Royal Navy ordered its first submarines. The 1914-18 war gave this type of craft an important place in warfare and since then many improvements have been made. In this photograph the submarine *Seraph*, stripped and streamlined for special exercises, is seen passing the destroyer *Battleaxe*

ABOARD A SUBMARINE

Photo. P.N.A.

Men selected for submarine crews are of high physical and mental standard. Our photograph shows a leading stoker making adjustments in the engine room at the end of a patrol.

Photo: Fox Photos

The periscope is the eye of the submarine when just below surface, and here we see an officer on the look-out for other craft during exercises in the English Channel.

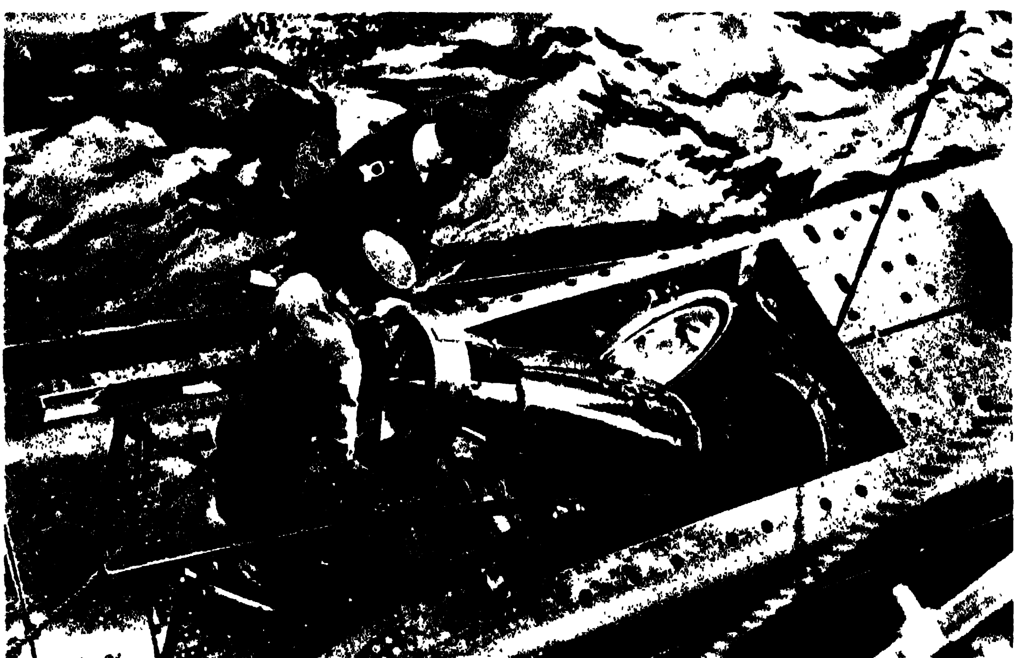
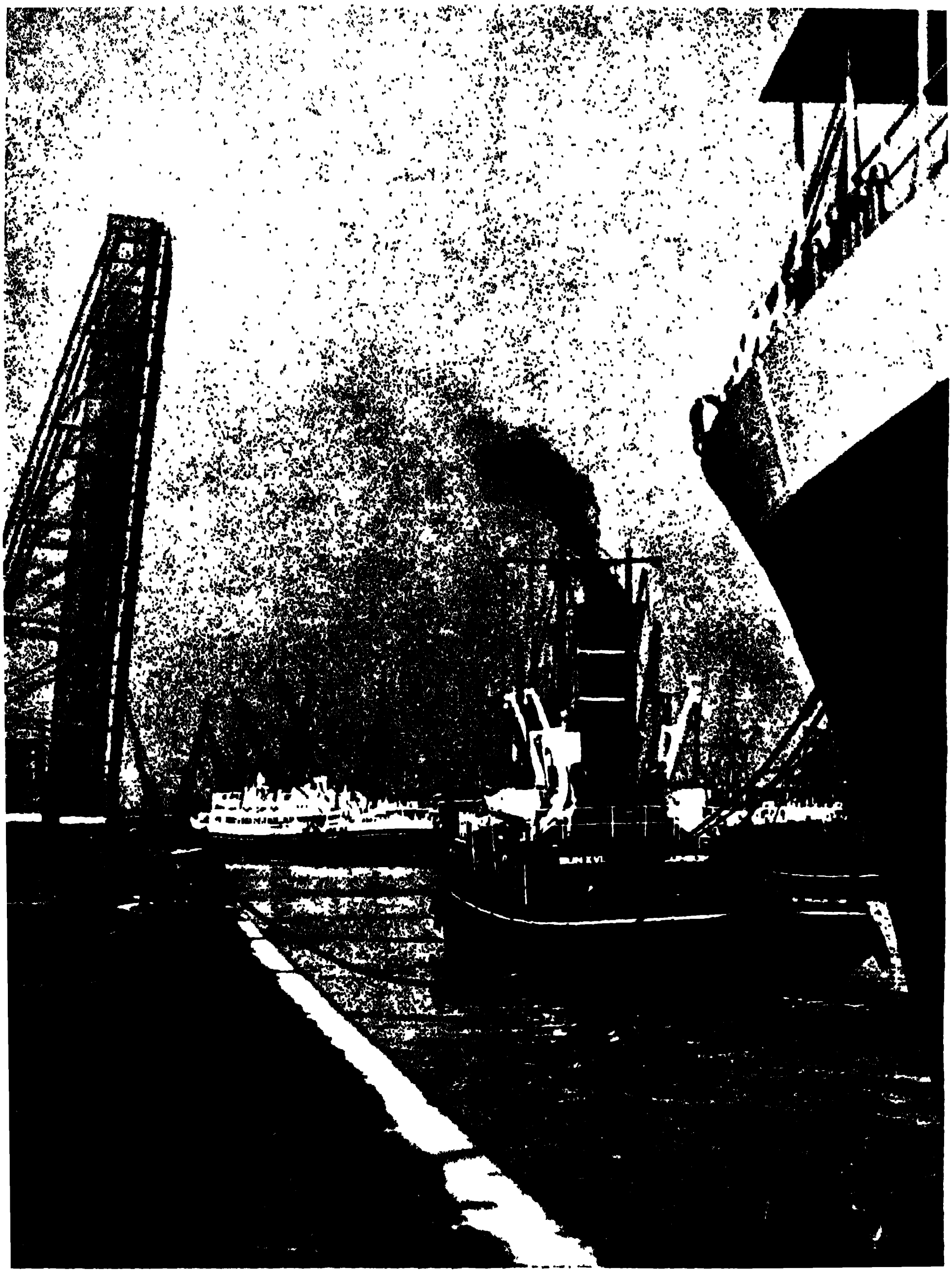


Photo : Fox Photos

In this photograph we see the final preparations being made aboard a submarine before the vessel sets out for whatever task or exercise it has been allotted. Torpedoes are the main weapons carried, and here we see two members of the crew helping to load the "tin fish" which, in peace-time, are recoverable after the exercise, while in war-time they may mean the end of some great ship.

DOCKING AT THE END OF THE VOYAGE



Stanley.

King George V Dock is one of the latest and most up-to-date in the world. It was opened in 1921 and has every facility for dealing with the loading and unloading of cargoes as well as for reconditioning ships in dry dock. In this photograph a tug is seen towing a large cargo ship, part of which can be seen on the right-hand side of the picture, through the entrance lock of the King George V Dock.

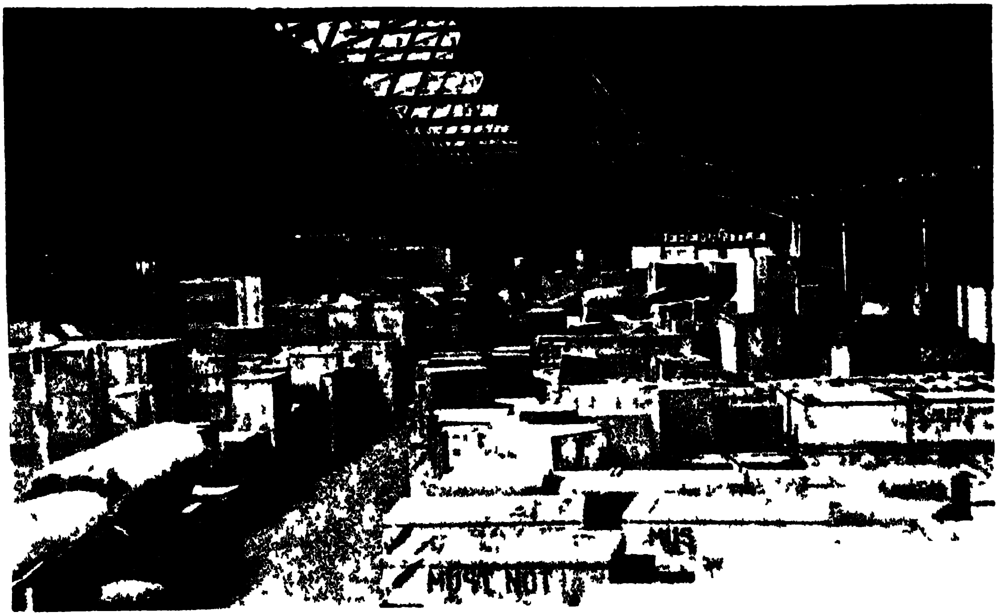
BROUGHT BY THE BIG STEAMERS

" For the bread that you eat . and the joints that you carve are brought to you daily by all us Big Steamers " wrote Rudyard Kipling in one of his poems In the two pictures on this page is evidence of the truth of these claims for the big ships that bring us our daily food Here we see grain being discharged by pneumatic elevators from the big cargo vessel into the barges alongside.

Photos P.L.A.

Here in this photograph are the joints that we carve, as Kipling puts it The cargo has been safely landed at the Royal Docks after its voyage in the refrigerated holds of the meat ship running between London and New Zealand Electric trucks and smaller barrows are busily employed carrying the different consignments from ship to store rooms to await distribution to all parts of the country.

PACKED AND READY FOR EXPORT

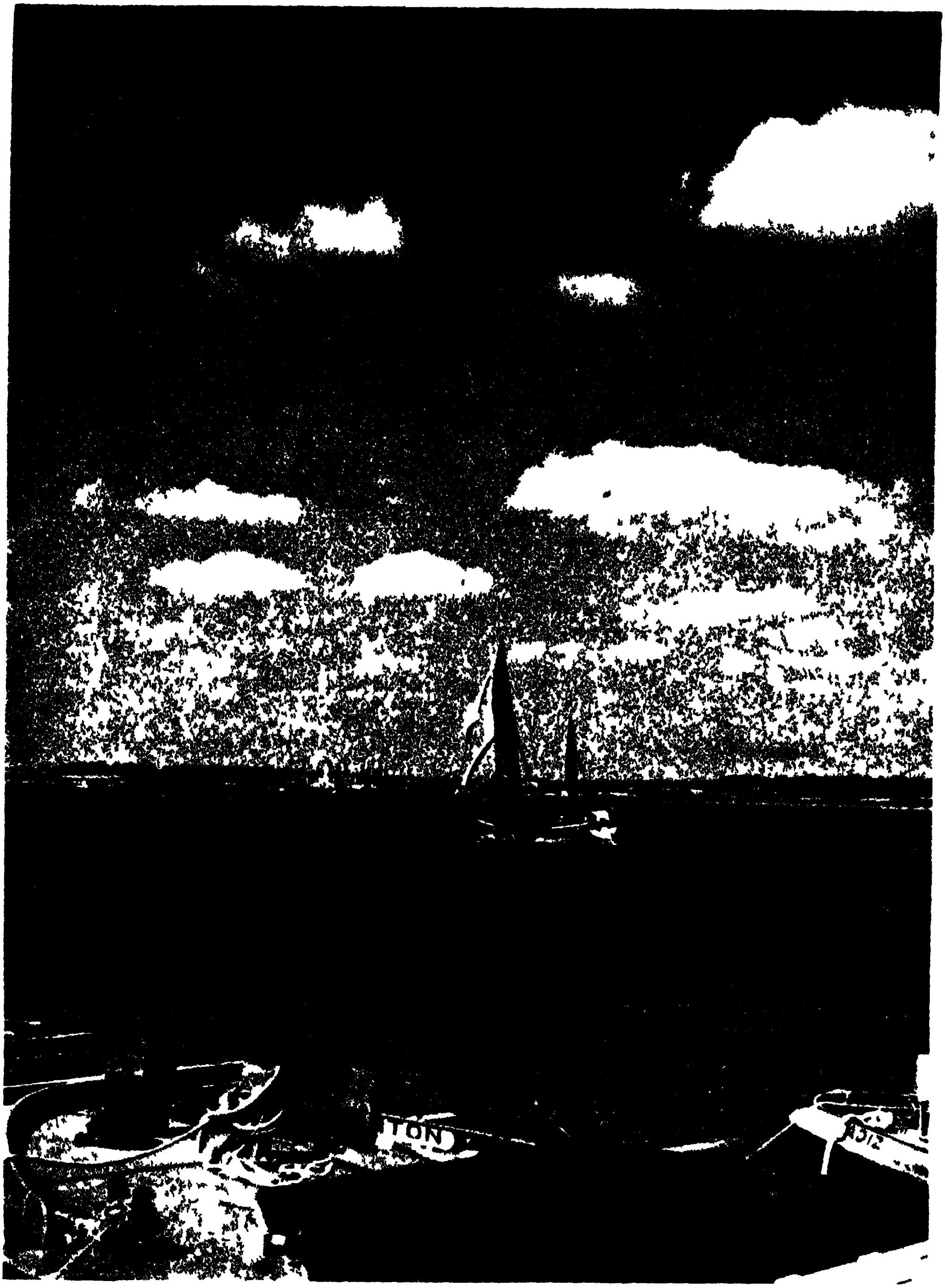


Every hour of the day goods packed for export to a thousand different places overseas come pouring into the London Docks. Here they are sorted and arranged in great transit sheds awaiting their turn to be taken by truck to the quayside when the cranes will lift the heavy packages seen in this photograph, swing them aboard and lower them into the holds of the different ships for which they have been marked.

P L A

This photograph, with its glimpse of the river through the forest of cranes, gives a good idea of the work that is handled in the Royal Dock of the Port of London. Once a cargo has reached port the next thing is to transport it to its final destination and, as seen here, the railway and the road run alongside the dock and the task of transferring cargo from water to land transport is facilitated.

A BARGE IN THE LOWER REACHES



Stanley

In this picture we are in the lower reaches of the Thames and have a view which is in contrast with the river as seen in the neighbourhood of London Bridge Our picture shows a Thames spritsail barge flying light and bound up Northfleet Hope in the lower Thames These barges are slowly becoming fewer in number as the competition of powered craft gradually forces them into retirement

Going into Dry Dock

The depth of the Thames decreases from the estuary inland and the distances which ships can steam up the river are limited by their draught. But even from London Bridge one may see ships of 6,000 or 7,000 tons unloading at one of the many riverside wharves.

As one sails down the river the really big ships of many well-known passenger and cargo liner companies can be seen. These great vessels link London with all parts of the world and make use of the Port of London Docks. Some of these fine ships have a registered tonnage up to 35,000 tons, and it is interesting to watch them being worked in or out through the narrow entrance of a dock by the special pilots entrusted with this duty.

A GIANT FLOATING CRANE *P.L.A.*

Mechanisation in all our great ports enables cargoes to be handled speedily. Pneumatic elevators for grain and specially designed conveyors for unloading meat and fruit are in constant use. In this photograph is seen one of the huge floating cranes, the "Titan," passing down the Royal Victoria Dock to help in unloading heavy cargo.

Any ship using the docks can be put in dry dock to have her hull examined and repaired, or cleaned and painted. The P.L.A. owns ten dry docks of various sizes, the largest of them in the Tilbury Docks being 750 feet long and 1,000 feet wide.

When empty a dry dock is seen to be a long cavernous pit, enclosed on the sides and at one end by walls sloping back in a series of great steps. Along the centre of the bottom is a row of keel blocks. If a ship is to be docked, water is let in till level with the water outside, then the gates, or "caissons" as they are called, at one end are opened and the ship manœuvred in by means of tug-boats. Great pumps then get to work and in a couple of hours or so the whole of her hull is bare and all the parts of the ship which have for so long been unreachable are exposed.

In many respects the equipment of the Tilbury dry dock is in advance of any other in the world. Mechanical bilge blocks obviate the use of the usual wood shores, and a "leading-in girder" automatically ensures the centralising of a vessel when floating in and being lowered on to the keel blocks.

ROUND OUR COASTS

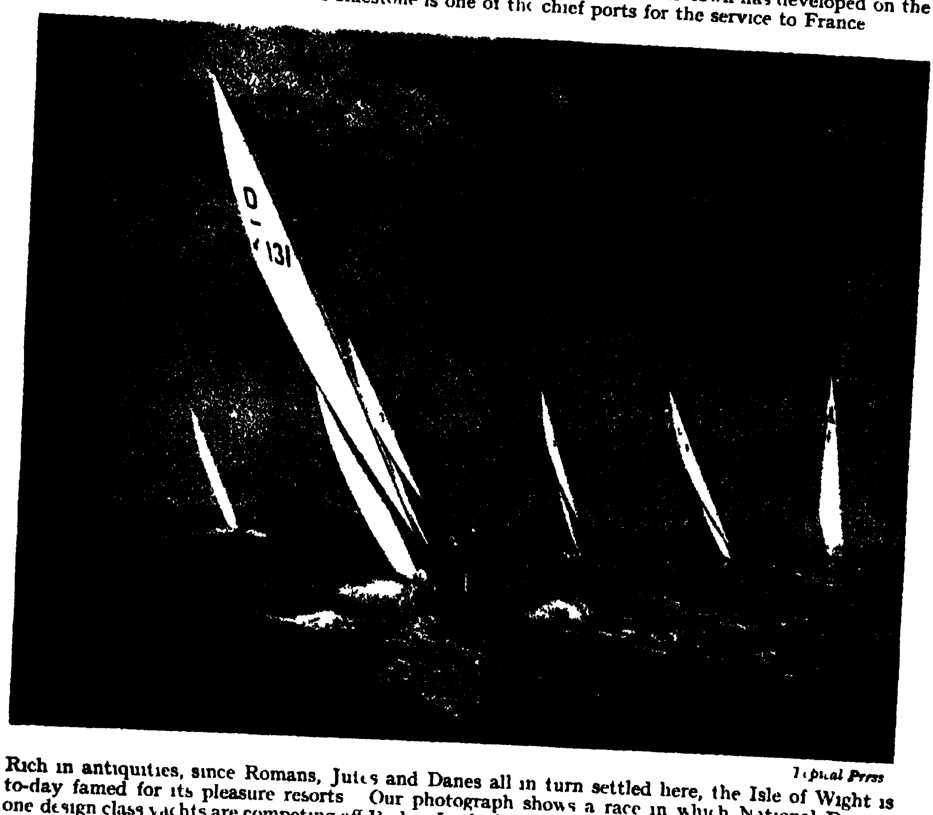
P. Thornton.

Here is a typical study of a sailor, home in port at Mallaig on the west coast of Scotland. It was taken during the herring season when many trawlers land their catches at Mallaig, which is both a railway and road terminus. Some of the trawlers have their own dogs which accompany the crews. The dog seen in the picture has, however, grown too old but likes to be down at the harbour when the fishing fleet comes in.

FOR FISHERMEN AND YACHTSMEN

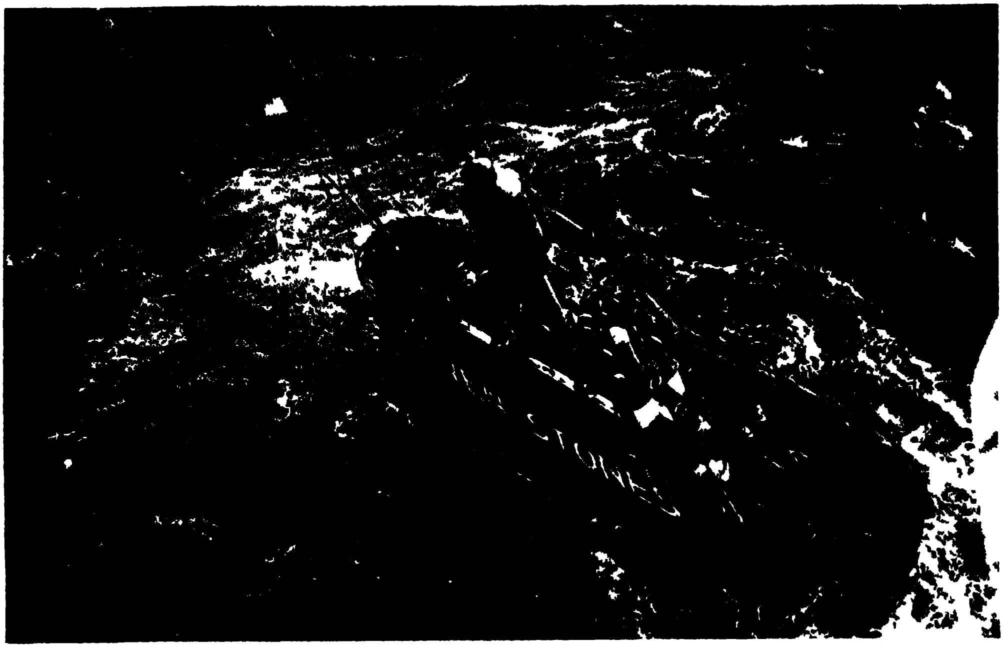
Before William the Conqueror landed on the south coast, Folkestone was a town and seaport. To-day the old town is still the fishing and shipping quarter, while the newer town has developed on the higher ground around. Folkestone is one of the chief ports for the service to France

Fox Phot



Rich in antiquities, since Romans, Jutes and Danes all in turn settled here, the Isle of Wight is to-day famed for its pleasure resorts. Our photograph shows a race in which National Dragon one design class yachts are competing off Ryde. In the background is the battleship *Queen Elizabeth*

Topical Press



Graphic Photo Union

Some forty lightships are stationed round our coasts to warn sailors of dangerous rocks and sandbanks The Seven Stones lightship, seen above, is some fourteen or fifteen miles due west of Land's End Though built in 1914, this lightship is fitted with siren fog signal and all the latest equipment

L N A

From early times the Goodwin Sands have been a source of danger to mariners, and many a gallant ship has come to grief on this ten-mile stretch of sandbanks off the east coast of Kent Four lightships are stationed here, and this photograph shows the East Goodwins lightship

TO GUIDE THE SHIPS AT NIGHT

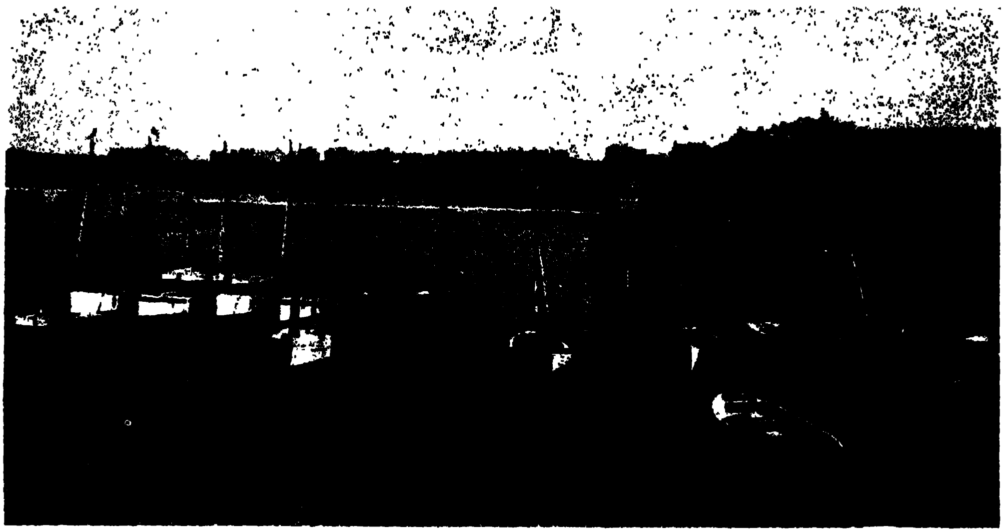
J Dixon Scott

One of the Seven Wonders of the World was the Alexandria lighthouse built about 260 B C In this country Trinity House has been responsible for lighthouses and other marks of the sea round our coasts since 1514 This photograph is of the Godrevy Lighthouse at Gwithian in Cornwall

Fox Photos

There have been four Eddystone Lighthouses The first was destroyed by a hurricane in 1703 the second was burned down in 1755 Smeaton's granite building erected in 1759 became unsafe the fourth, built in 1882 stands on Eddystone Rocks, 14 miles south west of Plymouth

THE LITTLE CRAFT AT ANCHOR

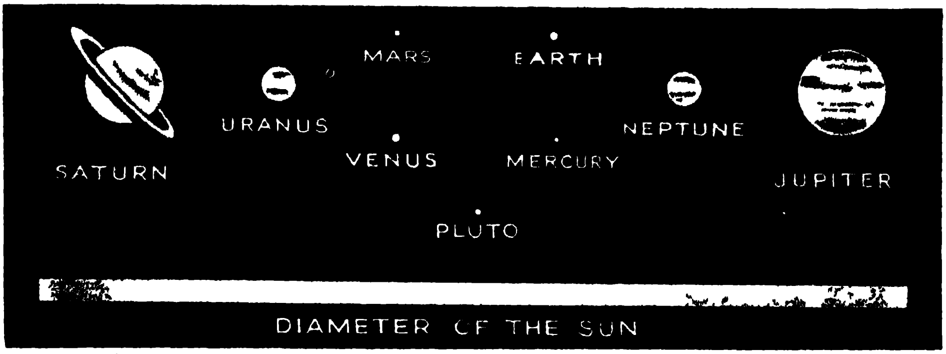


F. H. Moulton.

Most south-westerly of England's counties, with three sides bounded by the sea, Cornwall has always been a land of romance. To its shores came the Phœnicians, and nestling in its inlets are many fishing villages. Some such as Newquay, seen above, are better known to-day as holiday resorts.

Gerald Wilson.

Once an important shipping and oyster centre, the "Old Town" at Leigh-on-sea, now part of Southend-on-sea, has cockling as one of its main activities to-day. These are the craft used, and they lie at anchor at low tide off the sheds where the cockles they bring home are cooked and cleaned.



THE PLANETS AND THE SUN

The comparative sizes of the planets, showing also the huge diameter of the sun on the same scale

THE SUN AND THE MOON

THE early astronomers believed that the Earth was the centre of the universe and that all the heavenly bodies revolved around it. This was taught by Ptolemy, who was born at Alexandria about A.D. 127 in his great work, the "Almagest."

The Copernican Theory

The Ptolemaic System, as it was called, held for over fourteen centuries after Ptolemy's death, no one having the courage or initiative to suggest an alternative. It was left to Nicholas Copernicus (1473-1543) to show that it held many difficulties. Copernicus realised that the stars must be situated at a tremendous distance and that if they did travel around the Earth, as Ptolemy had taught, then the speed at which they must move, in order to complete a revolution in twenty-four hours, was too great for the theory to be practicable.

Copernicus asserted that the daily movements of the stars could only be accounted for by supposing that the Earth rotated on its axis. He also showed that the movements of the planets could be accounted for by supposing them to revolve around the Sun, each in its own orbit. He believed that Mercury and Venus moved in paths that lay between the Earth and the Sun, and that the paths of the other planets were outside that of the Earth. The Copernican System was later improved by Kepler and it is the accepted theory to-day.

Galileo and Kepler

It was through supporting the Copernican theory that Galileo came into conflict with the Ecclesiastical authorities. Galileo, who was born in 1564 at Pisa, was the first to apply the telescope to a study of the heavenly bodies. When he saw the four principal satellites of Jupiter revolving around that planet, he realised that he

THE SOLAR SYSTEM

Although in this diagram Mercury looks amazingly close to the Sun, it takes 88 days to complete one journey around the Sun, while the year of Venus, the next planet is 225 days Beyond the orbit of the Earth is that of Mars which revolves around the Sun in 687 days Beyond Mars are the Asteroids, of which the largest is only about 500 miles in diameter Giant Jupiter 1,300 times larger than our Earth, comes next, then Saturn, Uranus, Neptune and still further away, the most-recently discovered of all planets, Pluto, about which little is yet known

was looking at what might be regarded as a model of the Solar System. As a result of his teachings he was summoned (in 1633) before the Inquisition and made to kneel and repeat a declaration that said, in effect, that he was entirely mistaken in his belief that the Earth travelled around the Sun.

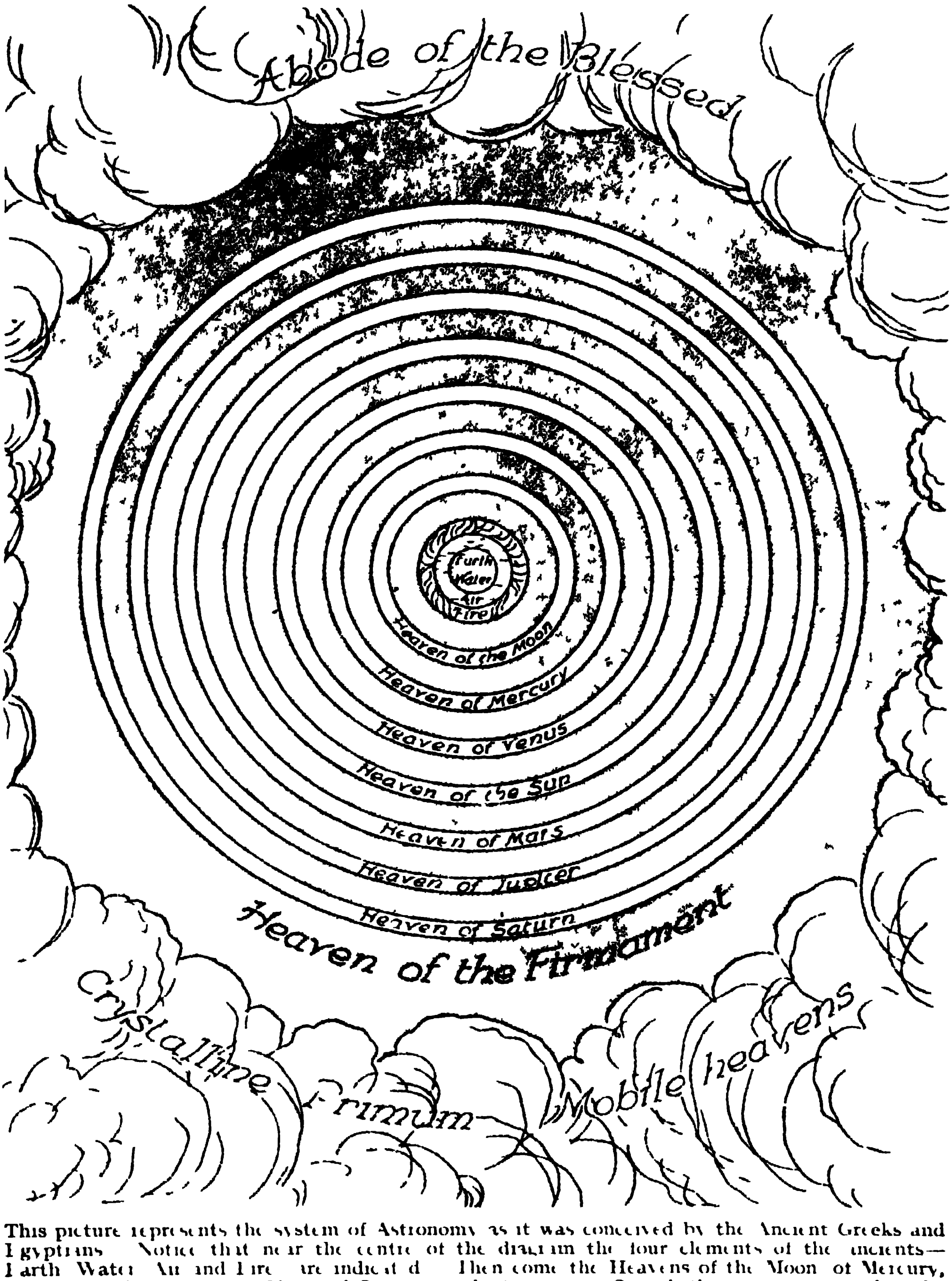
After Galileo's death (in 1642) his work was carried on by Kepler, who had promised Galileo that he would continue the investigations that had been made with so much self-sacrifice. Kepler studied the movements of the planets and discovered certain laws relating to their motions. For fifty years after Kepler's discovery the laws remained a complete mystery, and it was left to Newton to show that they were all consequences of a single law of gravitation.

The Solar System

We know to-day that far from the Earth being the centre of the universe, as Ptolemy believed, it is not even the centre of that particular part of the universe to which it belongs It is merely a planet—and a comparatively small one at that—circling round the Sun in company with eight other known planets, at least two of which are many hundred times larger than the Earth. The Sun and these nine planets and their satellites, asteroids, comets and meteors, are known as the Solar System. Pluto, the planet farthest from the Sun, was only discovered in 1930 by the astronomer, Tombaugh, at Lowell Observatory in America. Not sufficient is yet known about this comparatively recent discovery to say definitely whether it is a major planet or to be regarded as an abnormal minor planet.

The planets revolve around the Sun in paths that are known as orbits, to which they adhere year in and year

WHAT THE ANCIENT GREEKS THOUGHT ABOUT ASTRONOMY

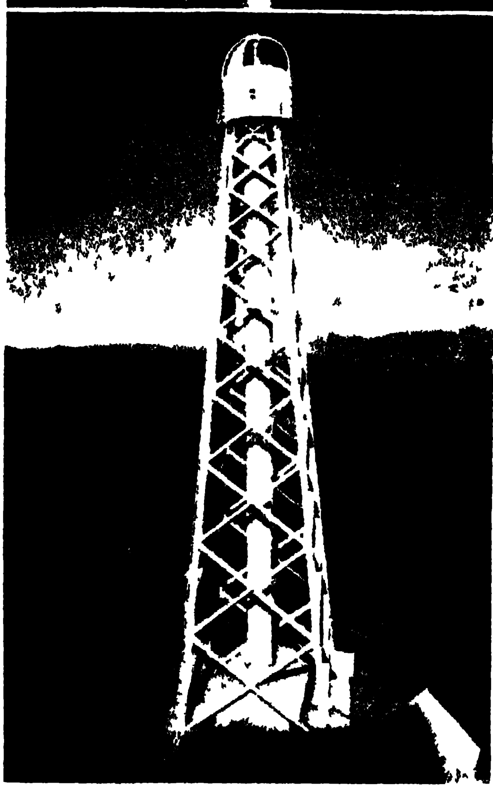


This picture represents the system of Astronomy as it was conceived by the Ancient Greeks and Egyptians. Notice that near the centre of the diagram the four elements of the ancients—Earth, Water, Air and Fire are indicated. Then come the Heavens of the Moon, of Mercury, of Venus, of the Sun, of Mars, of Jupiter and of Saturn. Outside these was supposed to be the Heaven of the Firmament in which the stars were fixed. The Moon, the planets and the stars were thought to be embedded in a series of hollow balls of crystal fitting inside one another and revolving at different speeds.

E N A

THE GREAT DOME

Being 7,000 feet above the sea, Mount Wilson Observatory is free from fogs and clouds. This domed building contains the great reflecting telescope that is used for studying and photographing the stars. The dome, which is 100 feet across, was the largest in existence until the completion of the Mount Palomar Observatory



TOWER TELESCOPE AT MOUNT WILSON

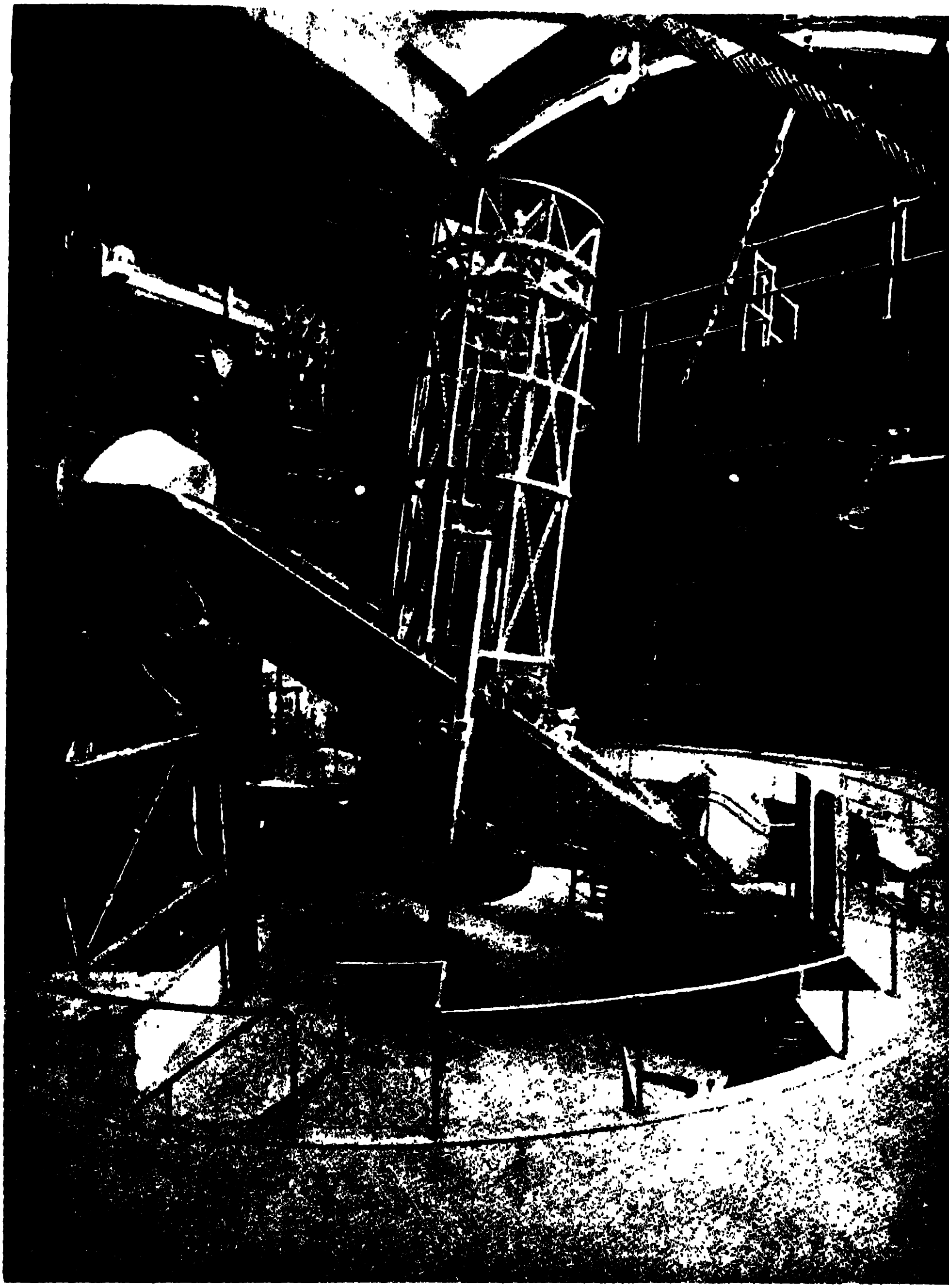
Mount Wilson Observatory was established by the Carnegie Institution. This photograph shows the new tower telescope, with which the Sun is photographed each day. It gives an image of the Sun 16½ inches in diameter

out. The orbits are not perfect circles around the Sun, but are eccentric, so that at certain times the planets are nearer to one another or nearer to the Sun than they are at other times.

Names of the Planets

The planets nearest to the Sun have smaller orbits than those further away, and they revolve around it in shorter periods of time. None of the orbits intersects another and there seems to be a certain amount of regularity in the placing of the planets, as we shall see when we come to consider the asteroids

ONE OF THE WORLD'S GREATEST TELESCOPES



Ellison Hawks.

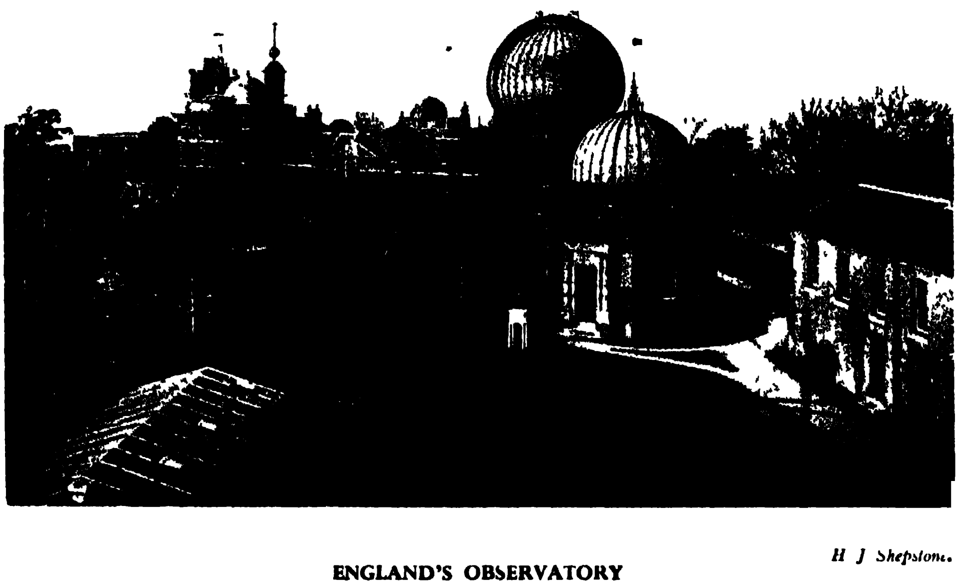
Mount Wilson's first telescope was a 60-inch reflector—that is, it possessed a concave silvered mirror 5 feet in diameter. This was followed by an even larger telescope, with a mirror 100 inches in diameter and no less than 12 in thickness. The grinding and polishing of this immense mirror was done in the Observatory's optical shop at Pasadena, a neighbouring town. The telescope, one of the largest of its kind in the world, is moved mechanically at a speed that exactly counteracts the movement caused by the rotation of the Earth.

The names of the nine planets in the order of their distance from the Sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. We can remember the order of the planets by memorising the following sentence: Men Very Easily Make Jugs Serve Useful Needs and Pleasures. The first letter of each word corresponds with the first letter in the name of each planet.

A Model to Scale

If we desire to make a scale model of the Solar System, we should require a globe 9 ft. in diameter to represent the Sun. On the same scale the Earth would be represented by a 1 in. ball at a distance of 325 yards, with the Moon a small pea 20 in. from the Earth. Jupiter would require an 11 in. globe a mile from the globe representing the Sun, with a 5 in. globe 5½ miles distant representing Neptune.

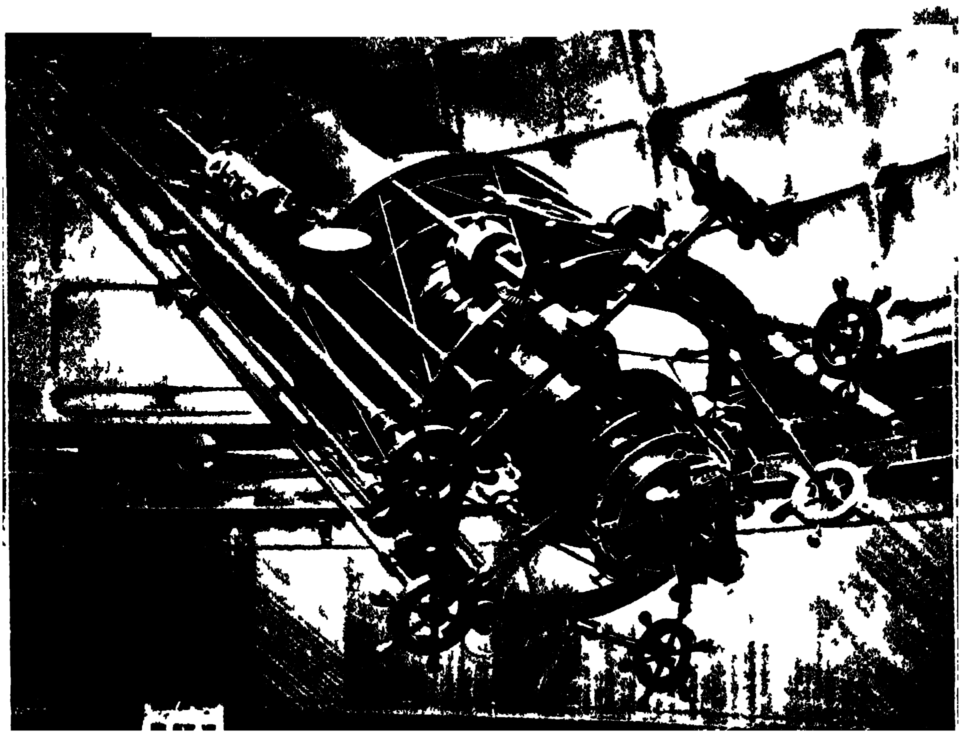
Each planet has some particular characteristic that makes it an object of special interest. Mercury is the smallest planet and the one nearest to the Sun. Venus—the planet nearest in size to the Earth—is sometimes called "the evening star," and is by far the brightest object in the heavens—with the exception, of course, of the Sun and the Moon. Mars, the fourth planet in order of distance, has peculiar markings that are supposed by some people to be canals made by the inhabitants of this other world. Jupiter is the largest of the planets, has nine satellites and a mysterious Red Spot. Saturn also has nine satellites and a wonderful ring system. Both Uranus



H. J. Shepstone.

ENGLAND'S OBSERVATORY

This photograph shows part of the Royal Observatory at Greenwich. Its importance is world wide as longitude is now universally measured from here and Greenwich mean time is known everywhere. Owing to deterioration in climatic conditions at Greenwich the Observatory has been removed to Herstmonceux Castle in Sussex but this will not entail any change in the prime meridian.



H. J. Shepstone

THE "BUSINESS END" OF A GREAT REFRACTOR

The huge telescope at Mount Wilson is a reflector. This picture shows the eye-piece end of another type of telescope called the refractor. This particular telescope, which is the second largest of its kind, is in the Lick Observatory at Mount Hamilton, California. Roughly speaking, the refractor is built like an opera glass or a sailor's telescope, but no refractor can be as large or as powerful as the largest reflector, owing to the difficulty in making very large object glasses.

and Neptune are the subject of interesting stories regarding their discovery. Pluto, the most distant, was the last to be discovered.

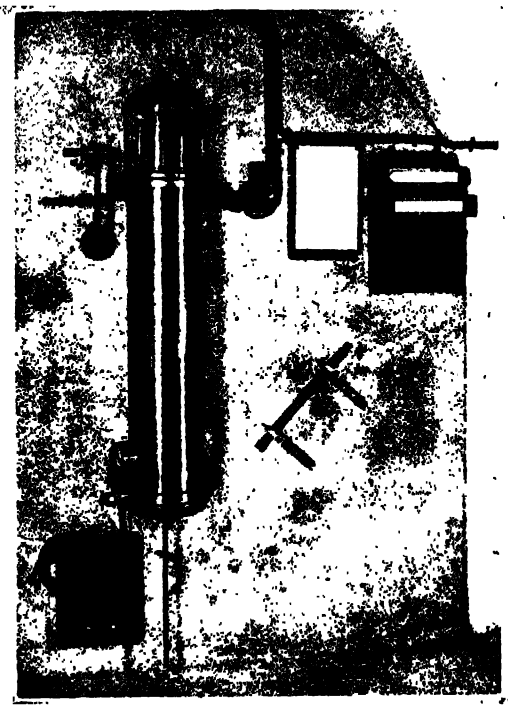
Density and Gravitation

Not only does the Sun provide light and heat for his family of planets, but he also holds them in their courses by the power known as gravitation. Most of you know how a magnet attracts light objects, and how a large magnet is able to lift larger objects than a small magnet. In a somewhat similar manner the Earth attracts objects to its surface, but in this case the attraction is by gravitation, and not by magnetism. The Earth is not the only body that attracts, for every body—whether it be the Sun, a planet or a satellite—attracts other bodies to its centre with a power that depends on its size and density.

It is not difficult to understand that the weight of an object on the Earth is really due to the force with which the Earth attracts to its centre. Having learned this, it is easy to realise that as the planets have different masses, the force of gravity in each must vary. To express this in another way, we may say that a certain object with a known weight on the Earth would have a different weight on different planets. For instance, let us suppose a 12-stone man is transported to the Sun. When he arrived there he would find that he weighed two tons, because every

thing on the Sun weighs twenty-seven times as much as it does on the Earth! The man's watch would weigh about 6 pounds, and the very act of lifting his arm would seem to him like moving an arm of solid lead. If he were unfortunate enough to fall down, he would not be able to rise, and if he once got into bed he would certainly never be able to get up.

On the other hand, if we could visit the Moon we should find that things weigh only about one-sixth what they weigh on the Earth. It would be a comparatively easy matter for a boy to jump over a house; and a hunter that on the Earth can jump a five-barred gate would leap over a haystack on the Moon with the same amount of exertion. A fielder at a cricket match who can throw in from 100 yards would be able to throw in from 600 yards just as easily on the Moon. At football the players would have to be careful that they did not kick the ball off the field and over the housetops — an extra strong kick would send the ball soaring into the next parish!



H. J. Shepstone.

A STAR CLOCK

This photograph shows the Standard Sidereal (or Star) Clock at Greenwich Observatory. This clock keeps accurate time and is regulated from observations of the stars. The chamber in which this clock is kept is maintained at a uniform temperature.

HOW FAR IS THE SUN FROM THE EARTH?

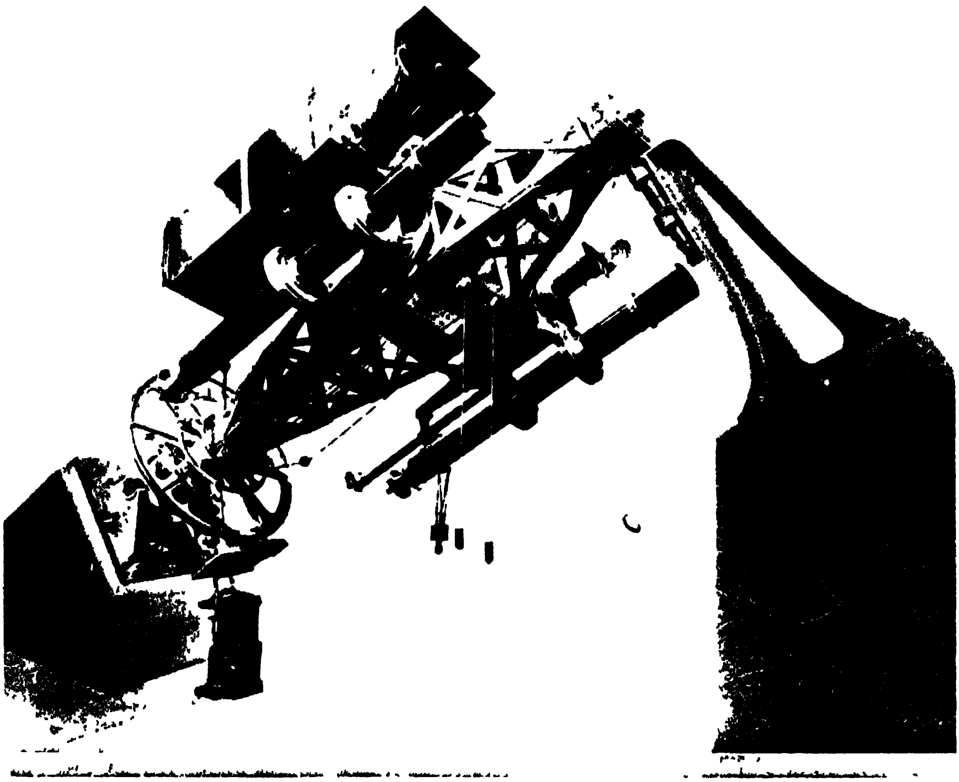
WE all know that the Sun is of the greatest importance to us, not only because it controls the movements of the Earth, but also because we depend upon it for light and heat. Even when the Sun is temporarily absent from the sky, as on a dull day, everyone seems to be affected by the absence of sunlight. Without the energy from the Sun's rays there could be no life on the Earth.

Although the Sun is to us the most important of all the heavenly bodies, it is surprising to think how few people stop to consider its size, distance, or composition. Indeed, this applies not only to the Sun, but to the heavenly bodies in general, in spite of the great interest they hold for us. In this connection a well-known philosopher has said that humanity is content to live its life much after the style of a race of moles!

Early Calculations

Mathematicians have devoted an enormous amount of time in the endeavour to measure the Sun's distance, which is one of the most difficult problems of Astronomy. Even at the present time the matter is not definitely settled and adjustments are constantly being made in the final figure.

Aristarchus of Samos, who lived in the third century B.C. was one of the first to attempt to solve the problem. He calculated that the distance of the



FOR PHOTOGRAPHING STARS

This strange-looking piece of machinery is a Franklin-Adams astrographic telescope. It is simply a camera combined with a telescope, and is used for charting the stars, for which work it is far more reliable than the human eye. Star-cameras are being used to make a chart of the whole sky

Sun was some twenty times greater than the distance of the Moon, but his result was about twenty times too little. Other astronomers—including Ptolemy, Copernicus, and Kepler—devoted time to the problem, but their estimates were all incorrect. It was not until 1673 that Cassini obtained a result more in accordance with modern measurements, when he decided that the Sun's distance was 87,000,000 miles. The modern figure for the distance is about 92,900,000—that is a little less than four hundred times the distance of the Moon from the Earth.

A Long Journey!

It is difficult for us to visualise such a figure, but we may get some idea of it by the following illustrations: If it were possible to lay a railway from the Earth to the Sun and to set off an express train, it would take that train over two hundred years to reach the Sun, assuming it did not stop day or night. In other words, if King George II. had taken a ticket for the Sun he would not have arrived there yet! According to the experiments of Helmholtz, an appreciable time elapses before a sensation reaches the brain. For instance, if we cut or burn our fingers, it is as though a message has to be transmitted from them to the seat of intelligence. Helmholtz decided that a shock of the kind men-

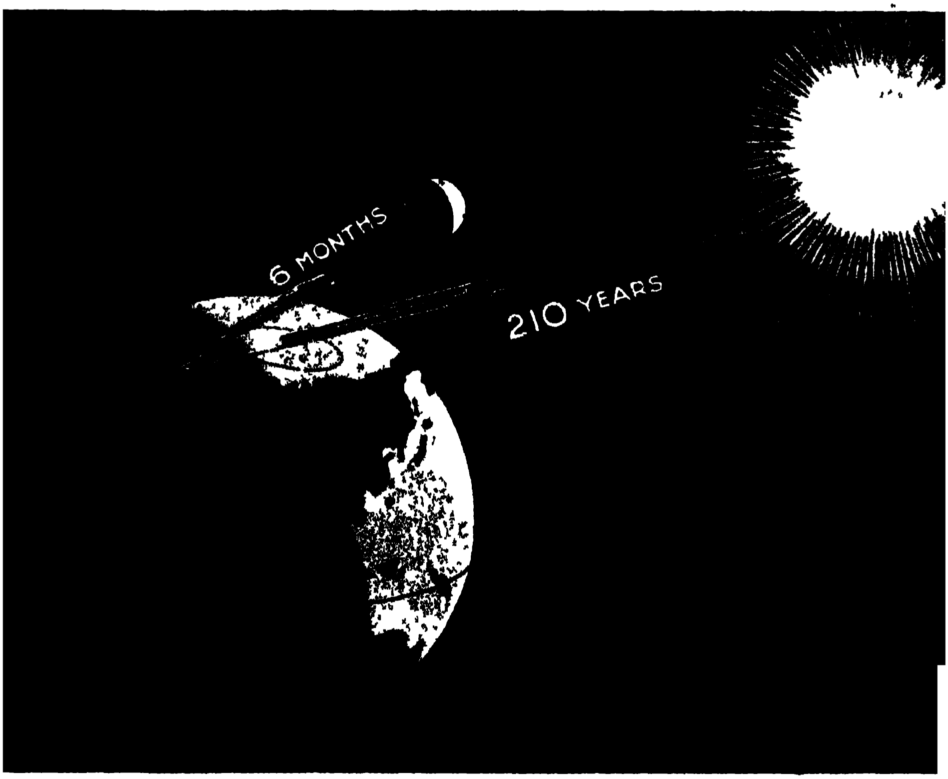
tioned travels from the injured member to the brain at the rate of about 100 ft. a second.

Let us imagine a boy with an arm long enough to enable him to reach to the Sun and that he burned himself when his fingers touched it. Then he would die of old age before the sensation could be communicated to his brain and before he felt any pain!

Why it is Hot in Summer

It is strange to learn that, to us in the northern hemisphere, the Sun is nearer in the winter than it is in summer! Actually, it is nearest to the Earth about New Year's Day and at its greatest distance about the 2nd July. It is not the difference in distance, which at the two dates amounts to nearly 3,000,000 miles, that causes the alteration of summer and winter. This is caused by the difference in the tilt of the Earth's axis, which on 21st June is so placed that the North Pole is inclined about 23½° towards the Sun. At this season, the North Pole receives sunlight all day, and the day is longer than the night in the northern hemisphere.

At mid-winter the conditions are reversed and the South Pole has sunshine all day whilst the North Pole has short days and long nights. In addition to receiving sunshine for more than half the day during the summer, the altitude of the Sun above the horizon is greater. This also has an



A LONG RAILWAY JOURNEY

It is easy to say that the Moon is 239,000 miles away and that the Sun is nearly 93 million mile distant, but figures mean very little to most people. This picture gives a much better idea of the distances between the Earth and the Moon and Sun. An express train leaving the Earth for the Moon and travelling night and day would reach the Moon in approximately six months, but the same train would require approximately 210 years in which to reach the Sun.

THE WONDERS OF SPEED

Specially drawn for this work

(1) Less than 50 years ago the express train travelling at a mile a minute was the symbol of speed (2) To-day a motor car can travel more than six times as fast, while aeroplanes (3) have flown at well over 600 miles an hour (4) A shell from a cannon is even faster covering a mile in less than three seconds (5) Yet all these man made speeds fade to nothing compared with that of the Earth on its journey around the Sun, which speed amounts to approximately 600,000 miles a day (6a and 6b) The fastest speed of all is that of wireless transmission and that of light Both travel at the same speed, 186 000 miles a second A wireless message would travel around the earth in one seventh of a second and light takes only nine minutes to reach us from the Sun

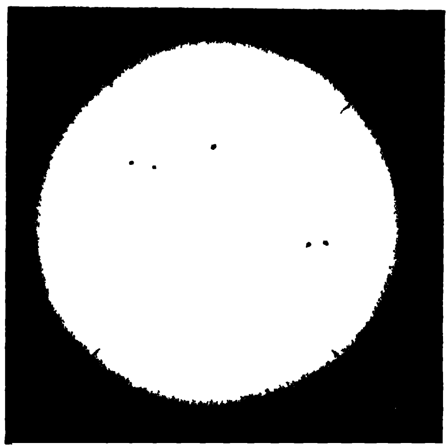
important bearing on the question of summer heat, for the more vertically the Sun's rays strike the Earth, the greater is the heat that they bring to each square yard of the surface.

ABOUT THE SUN

THE Sun is a hot, self-luminous globe, composed of a mass of highly heated gases. Its diameter is about 864,100 miles, so that, in comparison with the Earth, it is enormous.

It is difficult for us to imagine the great size of the Sun, but we can obtain some rough idea from the following illustration. If we were to suppose the Sun to be a hollow sphere with the Earth at its centre, the surface of the sphere would be 432,000 miles distant from the Earth. As the Moon is about 239,000 miles from the Earth, we can see that the Sun is large enough easily to contain the path of the Moon. In fact, the Moon's orbit would come only a little more than half way out from the Earth to the surface of the Sun.

If we wanted to make a "true-to-scale" model of the Sun and the Earth, we should require a globe 2 ft. in diameter for the Sun, and a very small pea (1/5 in. in diameter) would represent the Earth. In other words, about 120 planets of the same size as the Earth, placed side by side and each touching, would be required to stretch from one side of the Sun to the other.



THE SUN AND ITS SPOTS

The Sun is about 864,100 miles in diameter and is the centre of our system The tiny marks you see on his disc are sunspots The lines crossing the Sun in the photograph are cross wires in the telescope, to help to determine the position of the sunspots

The Sun's mass, which is determined by observing its gravitational attraction on the Earth, is 331,950 times that of the Earth. Should we desire to express the Sun's mass in tons, we should have to write down the figure 2 followed by twenty-seven ciphers! The true meaning of such a stupendous number—two octillions of tons—is, of course, too enormous for us even to imagine. It is this huge mass that causes the Sun to have its extraordinarily powerful effect on the planets that circle around it.

Although the Sun is infinitely larger than the Earth, its density is less. The Earth is four times as great in density as is the Sun, a fact that shows the Sun to be more or less of a gaseous nature.

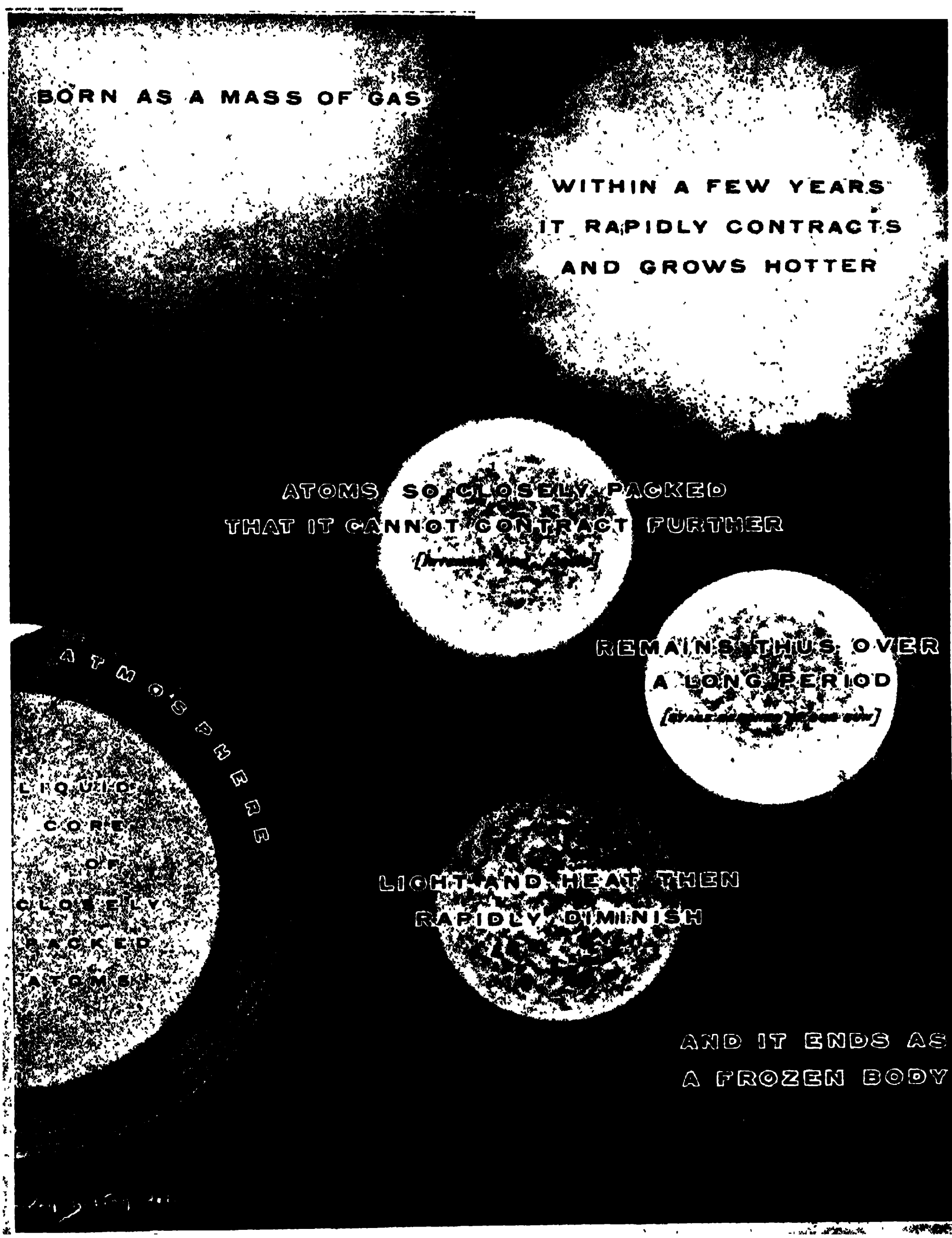
Extreme Brightness of Sunlight

We all know that sunlight is very bright and that it is dangerous to look at the Sun without protecting our eyes with smoked glass or in some other way. As a matter of fact, sunlight is the most intense light we know, being 146 times more brilliant than limelight. Perhaps the brightest light that we are able to make is that of the electric arc, but even this light appears dark when compared with sunlight. Careful observers have estimated the Sun's light to be at least four times as bright as the electric arc.

The Sun's Temperature

The sun's heat is no less intense, and it has been estimated that the tem-

THE STORY OF A STAR



A nebula consists of a huge cloud of gas. The atoms of which the gas is constituted are drawn together by gravity. The centre is molten and has a possible temperature of millions of degrees. This may persist for a very long period, even hundreds of millions of years, and is the stage that has been reached by our Sun. Then the molten globe begins to cool, and becomes what astronomers call a "white dwarf" star. Light and heat rapidly diminish, until in the end all heat has gone, and the one-time star becomes a dark and frozen globe wandering through space.

perature at the Sun's surface amounts to over 12,000° F. Experiments made by Sir John Herschel at the Cape of Good Hope caused him to conclude that the amount of heat received on the Earth's surface would melt an inch thickness of ice in about two hours and thirteen minutes. To express this in another way let us imagine a solid column of ice 2¼ miles in diameter and stretching from the Earth to the Sun. If the full power of the Sun's heat could be concentrated on to this gigantic icicle (nearly 93,000 000 miles in length) the ice would dissolve and melt in one second, while another eight seconds would be sufficient to dissipate it into vapour.

How is the Heat and Light Maintained ?

Scientists wonder how it is possible for the Sun to maintain its light and heat, the supply of which seems inexhaustible. Several suggestions have been made in this connection. One theory, which received considerable support some time ago, was that numerous streams of meteors were constantly attracted to the Sun, and by plunging into it caused a renewal of solar activity. Another theory—due to the great physicist Helmholtz—is that the Sun is slowly contracting. Helmholtz calculated that an annual contraction of about 250 ft. would be sufficient to account for the Sun's constant expenditure of heat and light. "But surely," you may say, "astronomers can find out if the Sun is contracting by measuring it ?" This is impossible at present, however, for so small is this contraction that something like 10,000 years must elapse before any reduction in the actual diameter of the Sun will become manifest, even if measured with the finest instruments—and telescopes have been in use only for a little over three hundred years !

A SUN STORM (1)

The storms that rage on the Sun's surface are terrific beyond conception They tear aside the white hot photosphere, or envelope of highly heated gas surrounding the Sun, and allow us to see the comparatively cooler regions below (*see illustration on next page*)

THE SPOTS ON THE SUN

EVEN a small telescope will show spots on the Sun's surface, and occasionally very large spots may be seen by the unaided eye. Before examining the Sun, however, always protect the eyes by looking through a piece of glass that has been smoked in a candle-flame, or by using the dark part of an exposed photographic film.

To understand the cause of sunspots we must first learn something about the nature of the Sun itself. The luminous surface of the Sun that we see is called the "photosphere," a word which comes from the Greek meaning "light-sphere." It is a kind of envelope of

highly heated gases surrounding the Sun in a somewhat similar manner to that in which the atmosphere surrounds the Earth. Seen through a low-powered telescope, the photosphere presents a mottled appearance not unlike that of rough drawing paper. When magnified the surface is seen to be made up of tiny markings, called "rice-grains" because they look like rice.

Great storms take place in the photosphere, and the bright surface of the Sun is ruptured and torn apart. Through the great hole that appears, we look into the depths of the Sun, which we see as a black spot. Although these depths appear dark they are not really so, being, in fact, brighter than molten steel and only appearing to be dark by way of contrast with the excessive brilliance of the photosphere.

A SUN STORM (2)

Here is the same sunspot as it appeared a day later than in the previous illustration. The spike-like markings are flames of incandescent gas. Although they appear small, they are thousands of miles in length. They are constantly changing in appearance.

How Big are Sunspots?

Sunspots vary in size from mere specks to great dark markings sufficiently large to be visible without optical aid. Even the spots that appear to be specks are some 500 miles in diameter, whilst the large ones may be 40,000 or 50,000 miles across. These large spots cover enormous areas, one having been estimated to measure over 3,500,000,000 square miles. One of the largest spots recorded, which was visible in February, 1905, was big enough to allow forty planets, each as large as the Earth, to pass through it without touching its sides. On this basis, assuming the Earth to be represented by a pea, the spot would be as large as a dinner plate.

As a rule, a sunspot is composed of two parts, the dark central part and a lighter fringe surrounding it. The dark part is called the *umbra* and the surrounding fringe the *penumbra*. Sometimes the *penumbra* entirely surrounds the spot, but at other times it may be broken and only be seen around part of it.

Sunspots are generally circular in shape, but they often take very beautiful and curious forms, with all manner of twists and turns. They change, too, from day to day or even hourly, and what may at first be a circular spot becomes distorted and mis-shapen as time goes on.

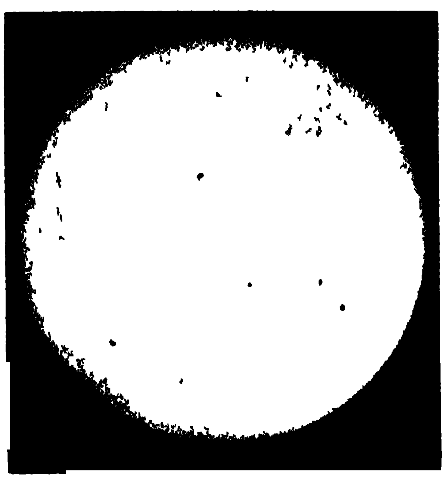
Sunspots may break out suddenly, or they may come into being slowly, in which case they are generally preceded by other disturbances. They may last for a matter of hours only, or for weeks—or even months in exceptional cases. In 1840 there was a remarkable spot that persisted for eighteen months. On an average, how-

ever, sunspots last only for from one to four days, during which time they undergo varied changes in appearance. They occur generally in particular latitudes of the Sun, the limit generally being between 5° and 40° north and south of the Sun's equator. Curiously enough, during the past fifty years the spots have been found to be slightly more numerous in the southern hemisphere.

Because sunspots are seen to move each day we know that the Sun revolves on its axis. In this it resembles the Earth, but whereas the Earth revolves in twenty-four hours, the Sun requires twenty-seven days. Thus it is that day by day a spot is seen to move slowly across the face of the Sun for about fourteen days. At the end of that time it is lost to our sight for another fourteen days, whilst it traverses that hemisphere of the Sun that is turned away from the Earth.

The Sunspot Cycle

In 1843 an amateur astronomer named Schwabe, who lived at Dessau, noticed that the number of spots varied greatly in different years. As a result of his observations, he discovered that the variation in the numbers was a regular one, increasing and decreasing throughout a period that he fixed at about eleven years. This period is now called the "sunspot cycle" and the time when the spots are most numerous is said to be the maximum, and the time when they are least the minimum.



Ellison Hawks

MORE SUN STORMS

Look carefully at this photograph and notice the tiny black dots. Each is a sunspot of huge dimensions. Sunspots sometimes cause magnetic storms and auroras. Considerable interruption of telegraphic and wireless transmission may result.

It is interesting to know that Schwabe's discovery of the sunspot cycle was made with the use of a small telescope. He was a most assiduous observer, and for thirty years he never lost an opportunity of examining the Sun with his telescope. He made over 9,000 observations, in the course of which he recorded 4,700 groups of spots. Schwabe's work is an outstanding example of what an amateur can do even with only a small telescope, for he made discoveries that had eluded professional astronomers, with all their equipment, for two hundred years.

We may here mention, perhaps, that sunspots were first discovered by Galileo when he turned his newly-invented telescope to the Sun over three hundred years ago. The famous astronomer was greatly surprised — and, indeed, perturbed — at what he saw, for up to that time the Sun had been regarded as a symbol of unblemished purity.

Sunspots have more than an astronomical interest, for at times they affect the Earth's magnetism. At periods of sunspot maximum extraordinarily beautiful displays of the *aurora borealis* are seen—a sure sign of disturbances in terrestrial magnetism. These magnetic storms are sometimes so violent as to change the direction in which ship's compasses point by 3° in as many minutes! They have also affected the telegraph service by interrupting its operation, one of the most remarkable

SUNSPOTS AT CLOSE QUARTERS

Here we are shown what sunspots or Sun storms look like when seen through a powerful telescope. If you compare the size of our Earth which you can see in the top left hand corner of the picture with the spots in the Sun's surface, you will gain some idea of the great size of the spots. These spots affect the Earth's magnetism and are sometimes the prime cause of ship's compasses changing the direction in which they point.

of such instances being that which occurred in 1909.

ECLIPSES OF THE SUN

IN the course of its revolutions around the Earth, the Moon sometimes comes between the Earth and the Sun, thus causing an eclipse. There are at least two eclipses of the Sun every year, and there may be as many as five. These eclipses may be either partial, annular, or total.

A partial eclipse is one in which only part of the Sun is obscured.

In an annular eclipse nearly the whole of the Sun is covered by the dark body of the Moon, but as the Moon appears to be smaller than the Sun, an uneclipsed ring of sunlight remains.

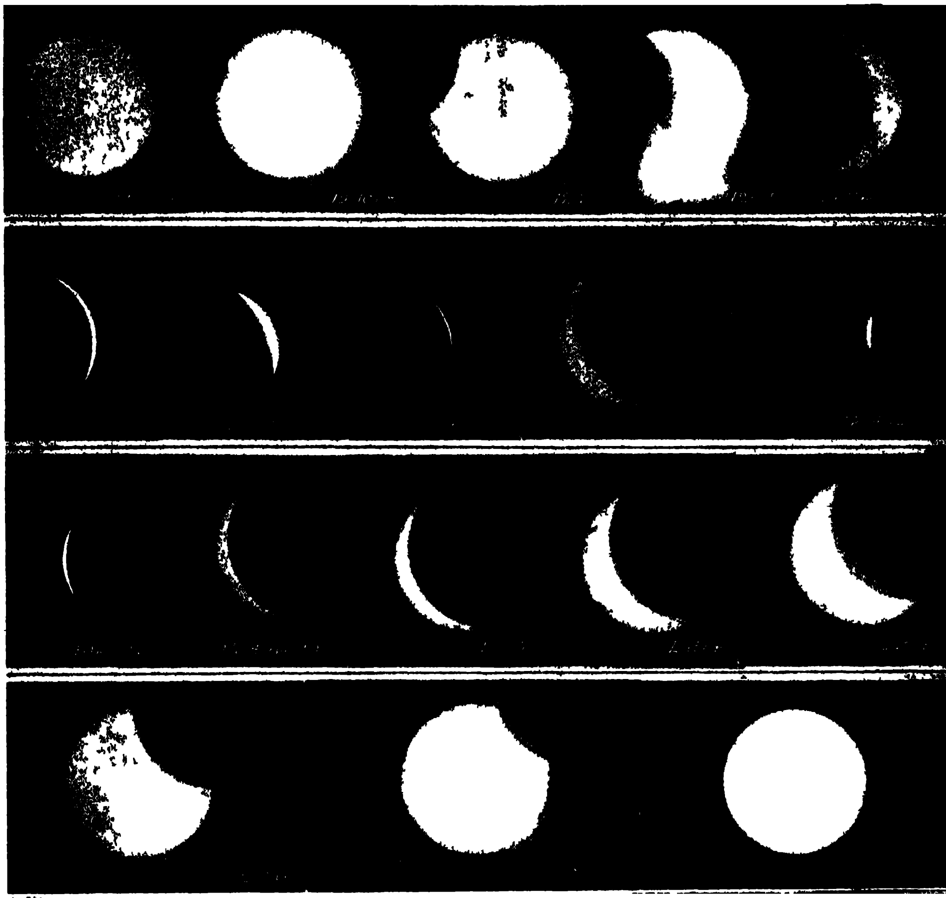
Total eclipses are by far the most interesting, and astronomers will willingly journey to the opposite ends of the Earth to observe them. A total eclipse is perhaps the most magnificent and impressive sight that Nature affords us. Little by little the dark body of the Moon encroaches on the bright disc of the Sun, until at last it completely covers it. If the observer is favourably placed he may see the shadow of the Moon sweeping across the land with awe-inspiring speed. The Moon moves in its orbit at a speed of about 2,100 miles an hour, and the shadow it casts travels easterly over the Earth's surface. At every place on which this shadow falls there occurs an eclipse of the Sun. The length of the shadow path may be anything up to about 8,000 miles, but the breadth is generally less than 100 miles at the widest part.

In addition to the motion of the Moon we must remember that the Earth is revolving on its axis at a speed of about 1,040 miles an hour. If we subtract this figure from the

Topical Press.

PHOTOGRAPHING AN ECLIPSE OF THE SUN

This photograph shows the telescopic cameras in place and ready for action at Bocaivu, a remote place in Brazil where a total eclipse of the sun was visible in May, 1947. A large group of scientists journeyed to this lonely, wooded plateau to watch the eclipse. The weather was favourable and the observations and photographs taken at the time were excellent.



THE PROGRESS OF A SOLAR ECLIPSE

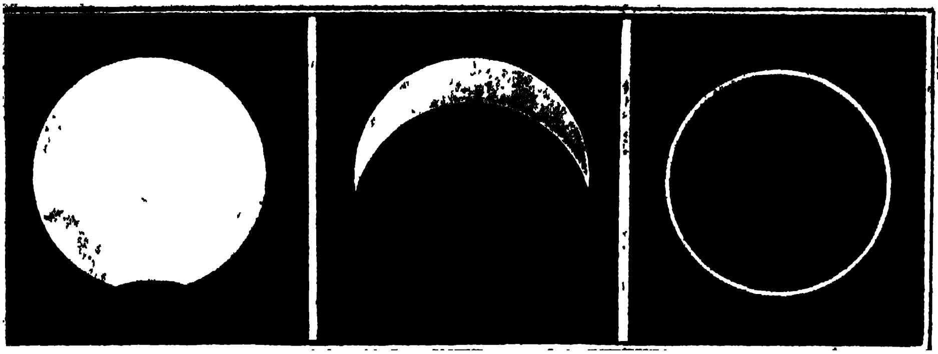
These photographs of different phases of a total eclipse of the sun were taken at Alor Star in Malaya The figures under the photographs show the time at which each was taken Although at times clouds partly hid the Sun the astronomers succeeded in obtaining (at 1 39) a photograph showing the corona at the moment of totality

Moon's speed we find that the shadow will sweep across the Earth at a rate of about 1,060 miles an hour

The Corona and the Prominences

When the Sun is totally eclipsed, the daylight becomes gradually less and a peculiar hush spreads over the land The wind drops, and an appalling stillness makes it seem almost as though the universe is on the verge of some great catastrophe When the last thin crescent of the sun disappears, the black disc of the Moon is seen surrounded by a wonderful halo of pearly light This is called the corona, and it changes in form from year to year, varying with the sunspot cycle At the time of the sunspot maximum short bright plumes are seen, but when the sunspots are fewest the corona throws off long streamers Sometimes these streamers, which consist largely of incandescent gases, stretch for millions of miles into space.

In addition to the corona, there are often seen rose-coloured flames around the edge of the Moon. These projections, which are called the prominences, are really masses of luminous



THREL FORMS OF SOLAR ECLIPSES

This diagram shows three different forms of eclipse, the first a small partial, the second a large partial; and the third an "annular." In this latter type of eclipse, the whole orb of the Sun is obscured except a narrow ring, for which the Latin name is "*annulus*" From this word is derived the name "annular."

gas in the process of being ejected by the Sun. Prominences often reach a height of hundreds of thousands of miles above the photosphere, and by studying them it has been possible to learn a great deal about the physical constitution of the Sun.

The Mountains of the Moon

During an eclipse it is noticed that the edge of the Moon is irregular, an appearance that is due to the lunar mountains. This irregular edge accounts also for the fact that when the Moon has almost covered the Sun the last crescent of brightness does not suddenly disappear. Instead, it breaks into a number of tiny points of light called Baily's Beads, which are seen just before and just after totality. They are caused by the last remnants of sunshine peeping through the spaces between the peaks of the Moon mountains.

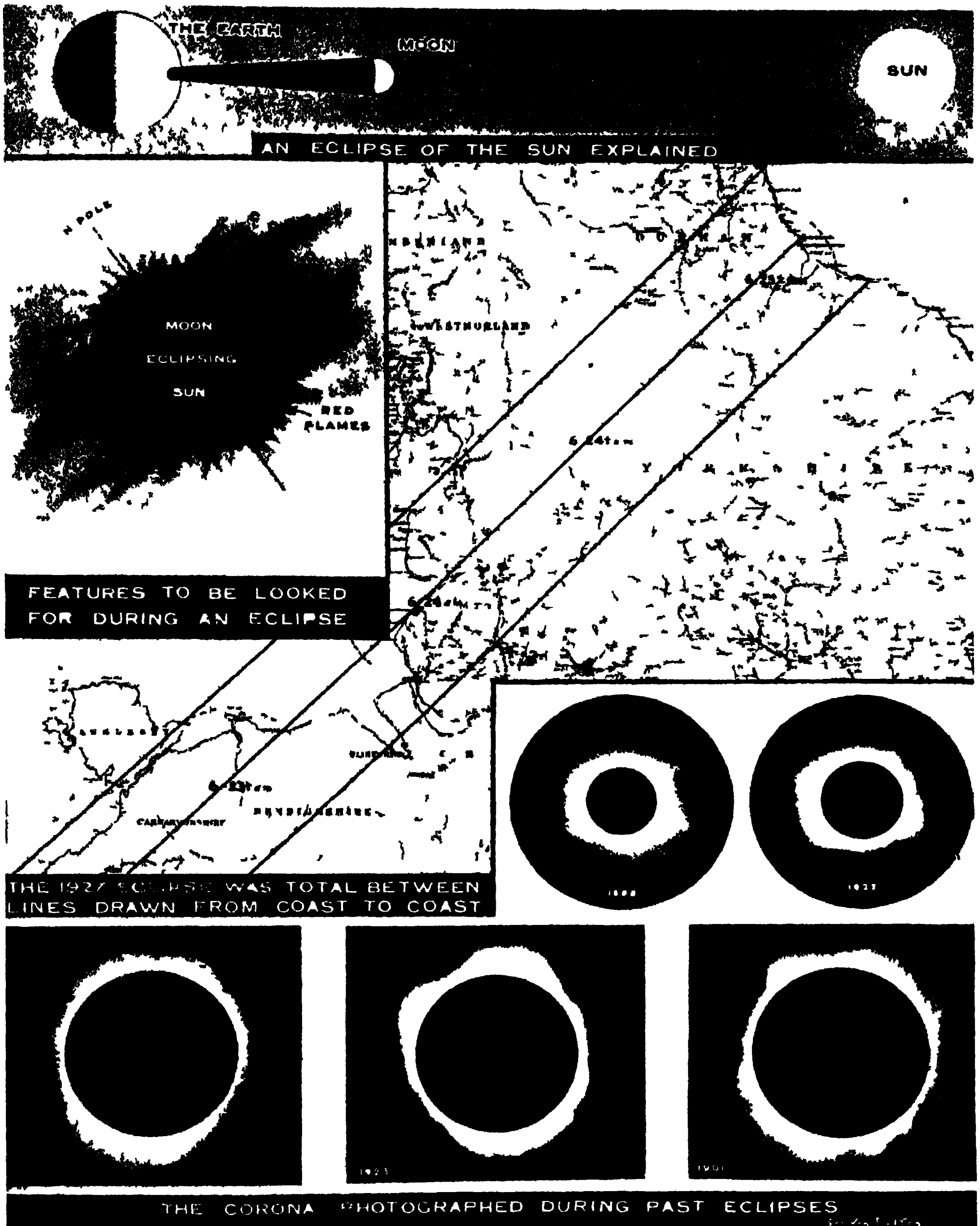
Historical Eclipses

Eclipses of the Sun have been observed from very early times. One of the earliest recorded is mentioned in the Chinese book "Chou-King," in which it is expressively written: "On the first day of the last month of Autumn the Sun and Moon did not meet harmoniously in Fang." It is believed that the eclipse referred to in this record occurred in either 2136 or 2128 B.C.

Both Greek and Latin historians recorded eclipses with particular care, because in those days their occurrence was supposed to foretell some disastrous happening. For instance, an eclipse that took place in 715 B.C. was thought to have been connected with the death of Romulus. In 585 B.C. there was an eclipse that has been of some service in helping historians to fix this year as the date of an important event in history.

Herodotus tells us that during a war between Lydians and the Medes, "just as the battle was growing warm, day was suddenly turned into night. . . . When the Lydians and the Medes observed the change they ceased fighting and were alike anxious to conclude peace." Curiously enough, there is no record of any eclipse having been observed in England until well into the sixth century. There are several records of eclipses in the Anglo-Saxon Chronicle. however, and here again we find that it was customary to associate these unusual events with adverse happenings.

A SOLAR ECLIPSE: CAUSE AND EFFECT



AN ECLIPSE OF THE SUN EXPLAINED

FEATURES TO BE LOOKED FOR DURING AN ECLIPSE

THE 1927 ECLIPSE WAS TOTAL BETWEEN LINES DRAWN FROM COAST TO COAST

THE CORONA PHOTOGRAPHED DURING PAST ECLIPSES

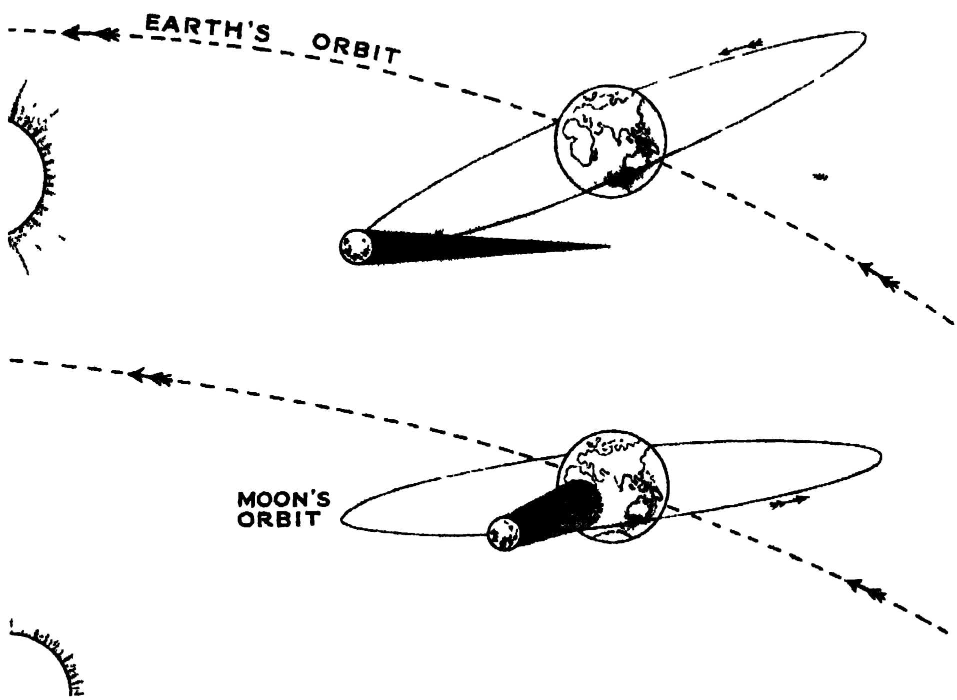
Map reproduced from the Ordnance Survey by sanction of the Controller of H.M. Stationery Office

The top illustration shows the Moon passing between the Earth and the Sun and casting a shadow on the Earth. Where that shadow falls is a total eclipse of the Sun. Below we see where the corona, chromosphere and prominences appear. The map shows the path of the eclipse of 1927 across the north of England. Below are photographs of the corona during totality in five different eclipses of recent times.

ECLIPSES OF THE MOON

AN eclipse of the Moon is caused by our satellite passing through the Earth's shadow. This shadow stetches into space for some 859,000 miles, the length varying according to the distance of the Earth from the Sun. Although the Moon revolves around the Earth every month, it does not always enter the shadow, but passes above or below it. It is only when the Moon is in line, or nearly in line, with the centre of the Earth and the centre of the Sun that an eclipse can take place, and this seldom happens more than twice a year. There may be one or even two eclipses each year, or on the other hand there may be none. It is a very rare occurrence if there are three eclipses in one year, but this will occur in 1985, when all the eclipses will be total.

If we examine a shadow we notice that it consists of shadows of two kinds. The central dark part, called the umbra, is surrounded by a half shadow, called the penumbra, a word that comes from the Latin *pene*, "almost," and *umbra*, "a shade." In the same way, the Earth's shadow is divided into umbra and penumbra. Sometimes the Moon does not enter the umbra, but passes only through the penumbra, resulting in what is called a penumbral eclipse. On other occasions the Moon only partly enters the umbra, passing to the north or south of its centre, when the eclipse is said to be partial.



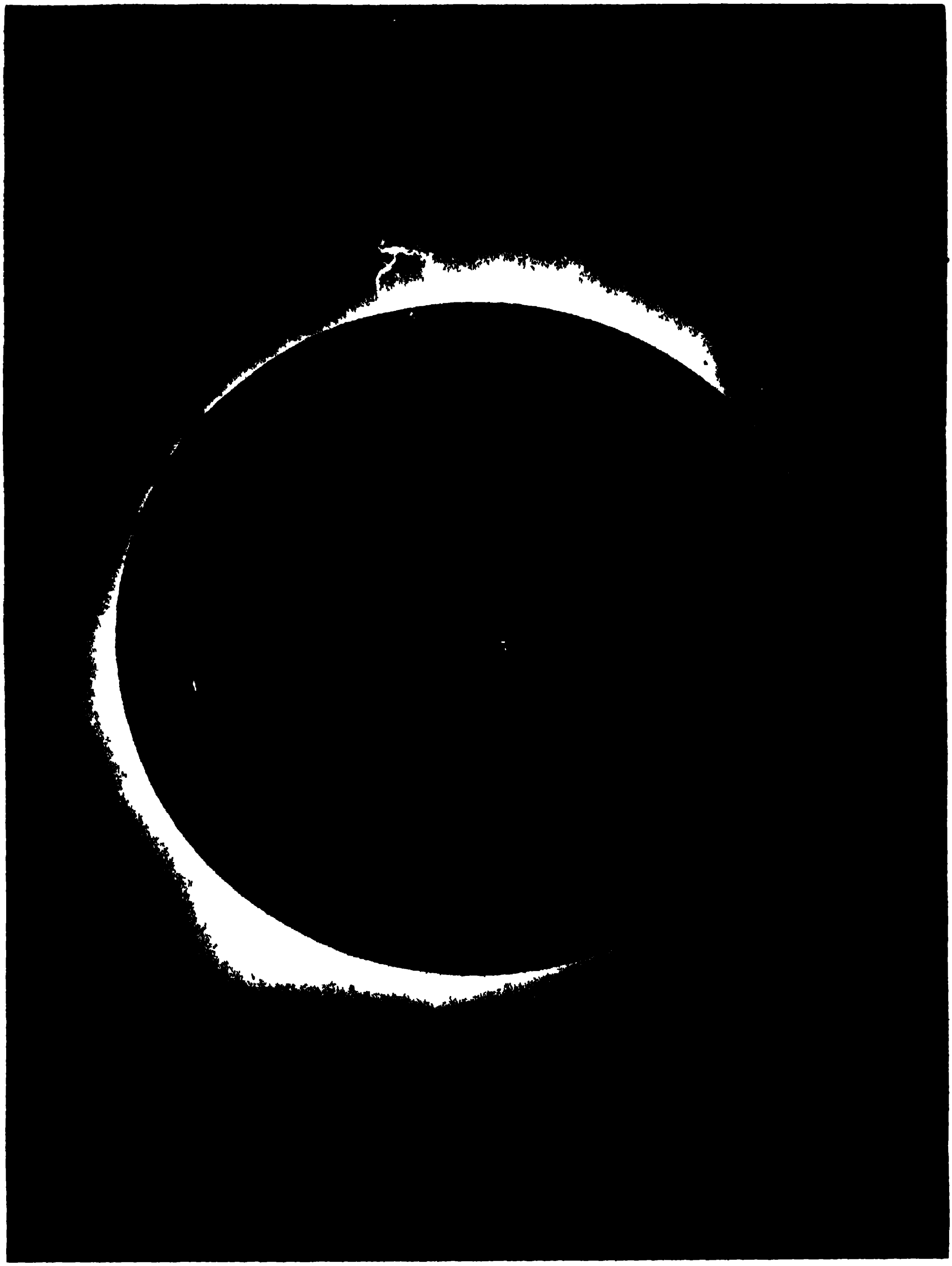
WHY A SOLAR ECLIPSE DOES NOT OCCUR EVERY MONTH

Solar eclipses are caused by the Moon passing between the Earth and the Sun There is a time in each month when our satellite comes between us and the Sun, but this diagram makes it plain why a solar eclipse does not occur every month The upper drawing shows that the shadow cast by the moon can miss the Earth altogether, the lower drawing shows one of the comparatively rare cases when the shadow strikes our planet

THE MOUNTAINS ON THE MOON

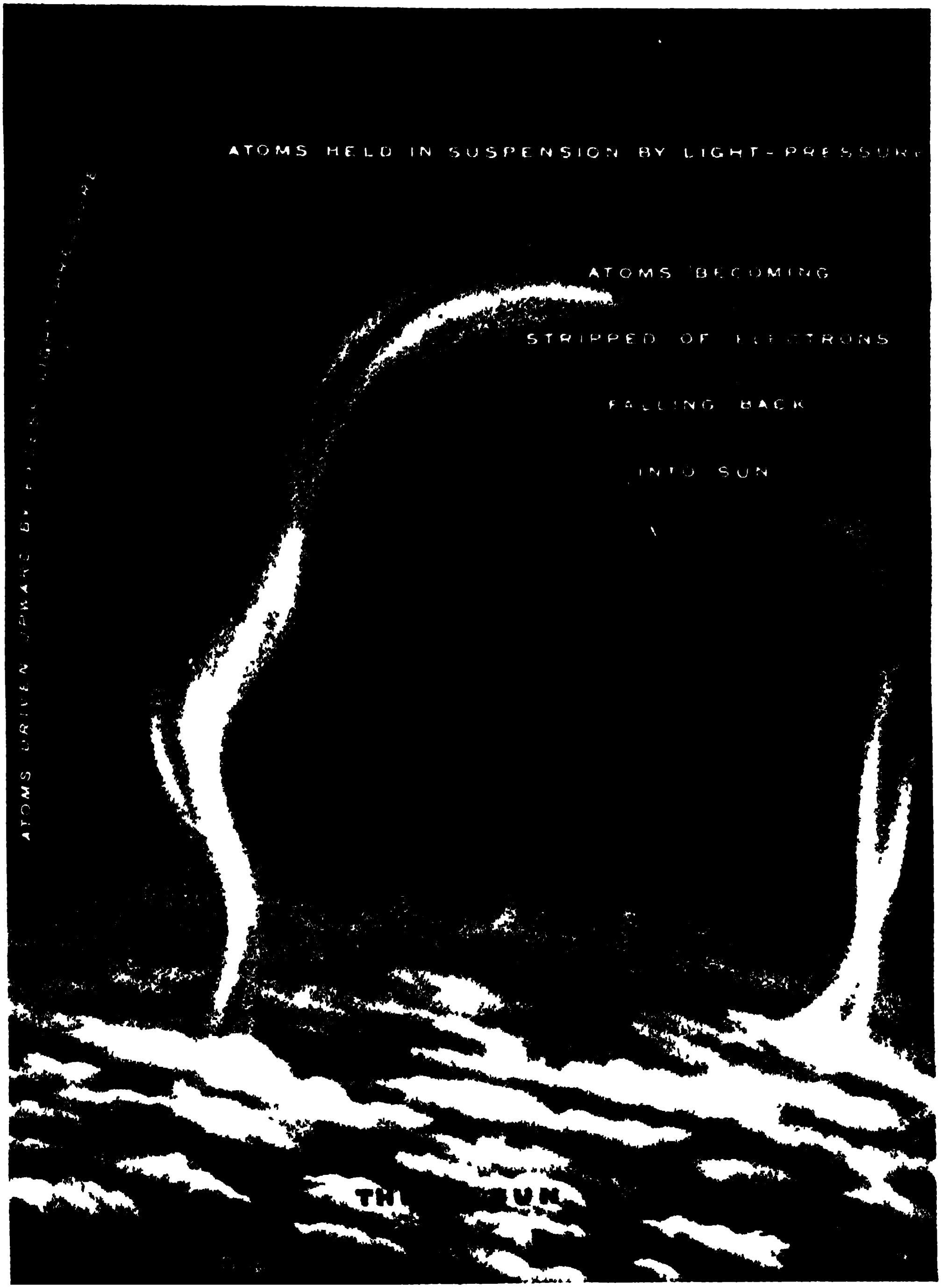
During a total solar eclipse, when the Moon comes between us and the Sun, we see that the edge of our satellite is uneven. This rugged appearance is caused by the mountain ranges of the Moon appearing in profile. Sunlight coming through the mountain valleys causes the interesting phenomena known as "Baily's Beads." Below is seen a remarkable phenomenon that occurs during a total eclipse.

A TOTAL ECLIPSE OF THE SUN

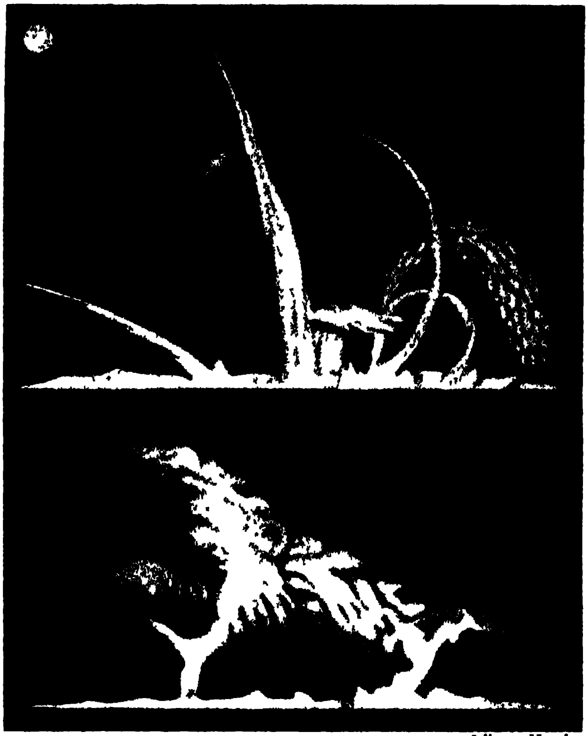


Turn back to page 125 and you will see a series of photographs of the total eclipse of the Sun taken at Alor Star on May 9th, 1929 Here is an enlarged picture at the moment of total eclipse, showing the corona—that is, the atmosphere of flaming gas surrounding the Sun, which extends outwards in great waves for thousands of miles The wonderful "prominence" seen at the top of the photograph is calculated to have been 180,000 miles long and 120,000 miles high The corona can only be seen when the Sun is totally eclipsed.

THE SURFACE OF THE SUN



This drawing gives us some idea of what we might expect to see if we could get a "close up" view of the Sun. From the incandescent masses of hydrogen, helium, sodium and calcium atoms are driven up an enormous height by the pressure of light. The atoms rise until the pressure of light and the effect of gravity balance one another. In that neutral area the atoms remain until "ionised," or stripped of their electrons, when they lose the support of light pressure, and fall back into the Sun.



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FANTASTIC FIRE CLOUDS

The upper picture looks like some strange plant and the lower resembles a very queer bird. Actually these are solar prominences observed during the eclipse of 1872 The prominences in the lower drawing stretched outwards to a distance of 70,000 miles, whilst those in the upper drawing extended 90,000 miles

The Earth's Shadow

The shadow cast by the Earth in space is cone-shaped. The duration of an eclipse varies according to the particular part of the shadow cone the Moon is passing through, depending on its distance from the Earth at the time of the eclipse. The Moon may remain totally eclipsed for about an hour and forty minutes whilst it passes through the shadow. It generally takes about two hours for the Moon to pass through the penumbra before entering and after leaving the umbra.

Whilst in the umbra the Moon does not entirely disappear, because the Earth's atmosphere refracts a certain amount of sunlight, bending the rays inwards towards the Moon and causing it to be fairly illuminated. The degree of this illumination varies according to the amount of light transmitted through our atmosphere, and this causes the eclipsed Moon to have different appearances. Sometimes it is seen to be dull grey, whilst at others it is of a beautiful copper colour.

During an eclipse of the Moon it is interesting to see that the shadow of the Earth, as it creeps across the Moon, is distinctly curved This was noticed even by ancient astronomers, two of whom—Manilius and Cleomedes, who lived some two thousand years ago -mentioned the fact to prove that the Earth was round. In those days, of course, telescopes were not known, and from this observation we can realise how keen must have been the sight of the ancient astronomers, and also the close attention that even then was paid to detail.

Named by Chaldeans

The Chaldean astronomers discovered that eclipses repeat themselves in the same order after an interval of eighteen years, eleven days, eight hours. In this period, which the Chaldeans named the Saros, there occur twenty-nine eclipses of the Moon and forty-one eclipses of the Sun. The fact that eclipses repeat themselves enables us to say, for instance, that the eclipse of 1932 was a return of the eclipses of 1914, 1896, 1878, 1860, 1842, and so on. We can also predict that this particular eclipse will occur again in certain years.

The ancient astronomers watched and carefully recorded eclipses of the Moon. As in the case of the earliest record of a solar eclipse, the earliest record of the lunar eclipse was made by the Chinese. It relates to an eclipse that took place in 1136 B.C. Many records of lunar eclipses were left by

Ptolemy and other ancient writers, but these eclipses are of little or no historical importance.

That knowledge of Astronomy may be of practical use was demonstrated by Columbus. In 1504 when at Jamaica, he had trouble with the natives who had refused to supply him with food. By predicting an eclipse of the Moon, Columbus gained a great reputation as a prophet. Commanding the respect that is accorded by natives to persons whom they believe to possess supernatural powers, he quickly found that the natives would obey him and he had no further difficulty in obtaining the supplies he required.

THE MOON, THE EARTH'S COMPANION

THE Moon is the Earth's satellite, a word that comes from the Latin *satelles*, meaning "an attendant" The moon is so named because it is the Earth's attendant in space It revolves around the Earth in the same way that the Earth revolves around the Sun; and it is held in place by the same force that holds the Earth in its orbit—gravity. The Moon revolves around the Earth in a month, and, indeed, this is how the term month comes to be used.

THE NEW MOON

The Moon, as we know, is dead, and has neither air nor water on its surface This is a photograph of the Moon a few days old, and as it is taken with a telescope it is up side down as compared with what the naked eye sees

ON THE WANE

In this photograph the Moon is just past "full"—that is, when the Sun's light illumines the whole of the side that is turned towards the Earth Our telescopes tell us much about the surface of our satellite we even know the height of the lunar mountains.

Distance of the Moon

The diameter of the Moon is about 2,160 miles, so that it is rather more than a quarter of the diameter of the Earth. Its distance varies, and although at certain times it is nearer than at others, its mean distance from the Earth is about 239,000 miles. It may recede to about 253,000 miles or approach to within 221,000 miles. If we were able to lay a railway from the Earth to the Moon, and to set off an express train, it would take the train over six months to reach its destination travelling day and night.

A MOUNTAIN OF THE MOON

This is a picture of one of the greatest lunar craters called Copernicus. The whole surface of the Moon is covered with thousands of craters, some of enormous size. If you stood on the rim of Copernicus you would look down over sheer cliffs thousands of feet in height [illegible]

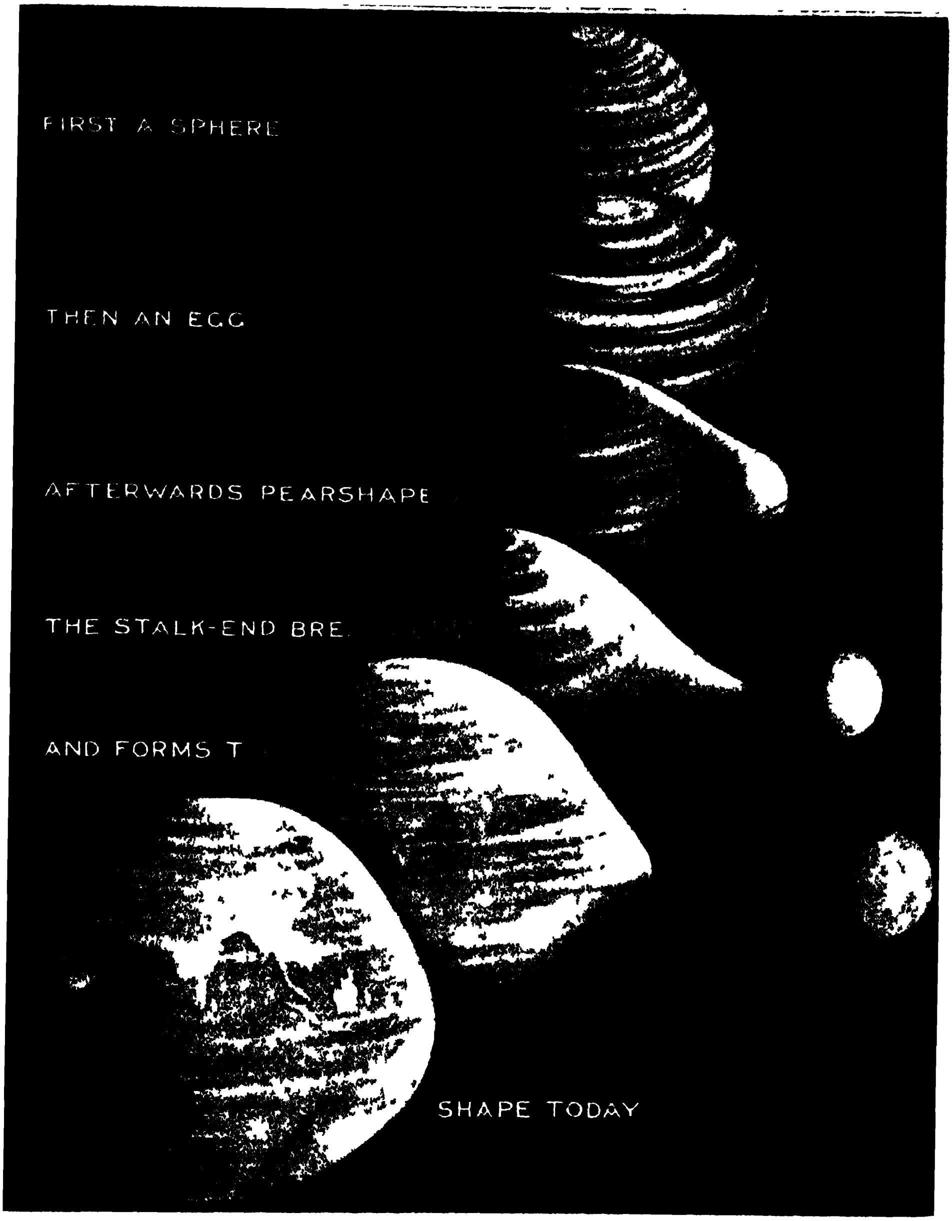
The changes in the appearance of the Moon from "new" to "full" troubled people in bygone times. Even to-day there are tens of thousands of educated people who could not give a correct explanation of the "phases," as they are called. The Babylonians thought that the Moon had a dark and a bright side, and that throughout the month she turned the bright side towards the Earth until at last the whole of it was seen. Aristotle was the first to give the correct solution of the phases, which are due simply to the different positions from which we view the illuminated portion of the Moon's surface, during the time she is moving round the Earth.

The Moon's Phases

Like the Earth, the Moon is a dark body and is composed of similar materials to those that constitute the Earth. She does not possess any illuminating powers of her own but shines only by reflected light from the Sun. On a clear night when we see the silvery Moon, it is difficult to believe that this is the case. We have only to remember, however, that at the time of a lunar eclipse, when the Moon passes through the Earth's shadow, the Moon no longer presents a bright disc, for then the sunlight is cut off.

When the Moon passes between the Earth and the Sun it is invisible, as all the sunlight falls on the part of her surface that is turned away from us. As she moves round her orbit, however, part of her surface that is visible to us becomes illuminated, and is seen as a crescent "new" Moon. Night by

WAS THIS HOW THE MOON WAS BORN?



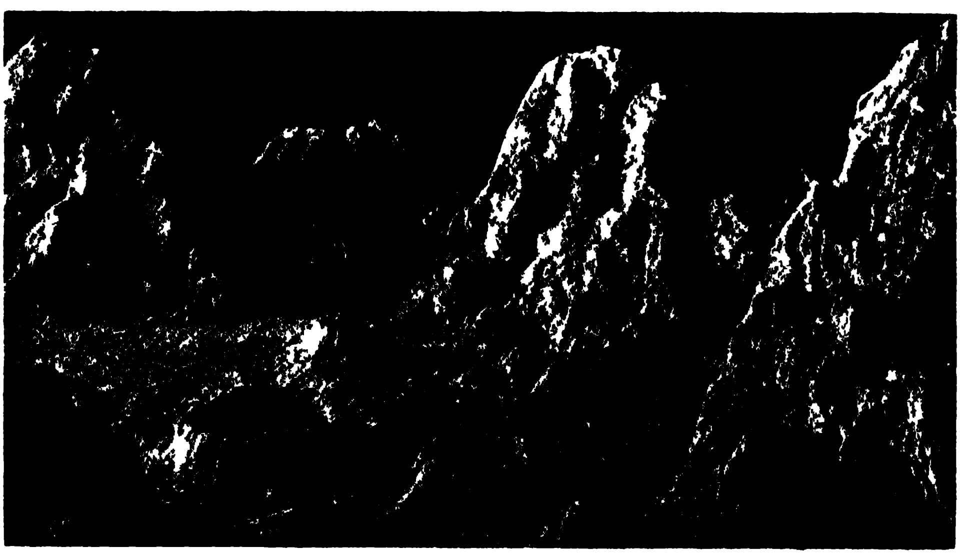
These pictures show how some scientists think the Moon came into being At the top is the Earth millions of years ago, still a pasty mass of intensely hot material and spinning at furious speed It flattens and gets wider at the waist line A weakness develops and it bulges By the speed of its spin the bulge gets longer and becomes a stalk and finally breaks off to become the Moon which assumes the shape of a globe The Earth itself gradually regains its globular form, and the Pacific Ocean fills the hole left by the tearing away of the Moon

night this illuminated part increases until we get "half" moon. At the time of "full" moon the Earth is in line between the Sun and the Moon, and the whole of that hemisphere turned towards us is illuminated.

The Crater-rings in the Moon

The Moon is perhaps the most interesting of all the heavenly bodies; even in a small telescope with the naked eye we can see certain dark markings, and these have been likened to faces, figures, and animals. The "Man in the Moon," and the ancient legend that he was put there for gathering sticks on a Sunday, is familiar to everyone. The dusky markings that help to form such pictures were supposed by the ancients to be a reflection of the Earth's markings, for they imagined that the Moon was a great mirror hanging in the heavens Galileo saw that the markings were due to actual features on the surface of the Moon. Although he came to the conclusion that the markings must be seas, we now know that there is no water on the Moon. Perhaps these markings may be the beds of ancient seas, but to-day they are bare and desolate plains without water or vegetation.

Even with a pair of field glasses we can see numerous circular objects scattered over the Moon's surface. With the telescope these are seen to be crater-rings, of which there are many thousands. Each has its name, for the surface of the Moon has been so carefully mapped that we know its details better than we know those of some parts of the Earth Altogether some 30,000 craters have been mapped, but this number forms only a small part of the whole, it having been estimated that there are something like 200,000 craters to be seen In observing these crater-rings we must remember that we are obtaining a bird's-eye view of the Moon If we imagine that we are hovering over the



IF YOU STOOD ON THE MOON

Here we have an artist's conception of the lunar scenery There is no trace of vegetation as we know it on this dead world, and except possibly in the deepest valleys there is no atmosphere During the lunar day the heat must be fearful, while throughout the long night the cold is so great that any water or water-vapour must be turned to snow.

THE VALLEY OF THE ALPS

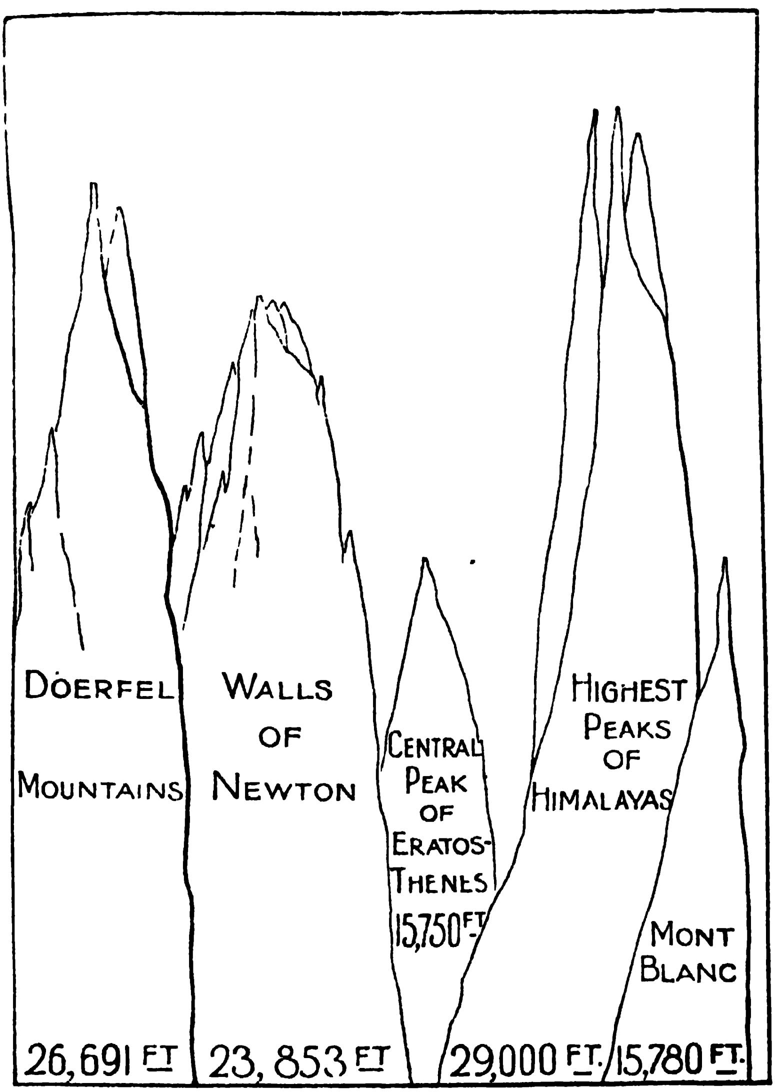
The mountains in the centre at the lower part of the photograph are the lunar Alps. The peculiar streak marked X is a great valley - perhaps something like the Colorado Canyon. How this valley was formed is a mystery, but some astronomers think its origin may have been due to the fall of a great meteorite that crashed through this mountain range, clearing all before it.

Moon in an aeroplane, and looking down upon its surface, we can understand more clearly what we see.

Sunrise in the Lunar Mountains

Most of the lunar craters have been carefully measured and many are found to be of huge size. One, for instance, named Ptolemæus is 115 miles across; another, Plato, is sixty miles across. A walled plain named Schickard has a diameter of 133 miles, while Grimaldi and Clavius are even larger, being 138 and 142 miles in diameter respectively. It is interesting to find that in comparison with the size of the Moon the heights of the lunar mountains are relatively far greater than are the mountains of the Earth. For instance, the height of the Döerfel Mountains is 26,691 ft., which compares with the 29,000 ft., the height of the highest peak in the Himalayas. There are at least thirty-nine mountains each higher than Mont Blanc, the height of which (15,780 ft.) is in several cases easily surpassed.

One of the finest sights that can be seen through a telescope is to watch the sunrise on the lunar mountains. One can observe the light gradually spreading down the peaks into the valleys. Little by little they are illumined, until at length—at the time of full Moon—the whole surface is bathed in glorious sunlight.



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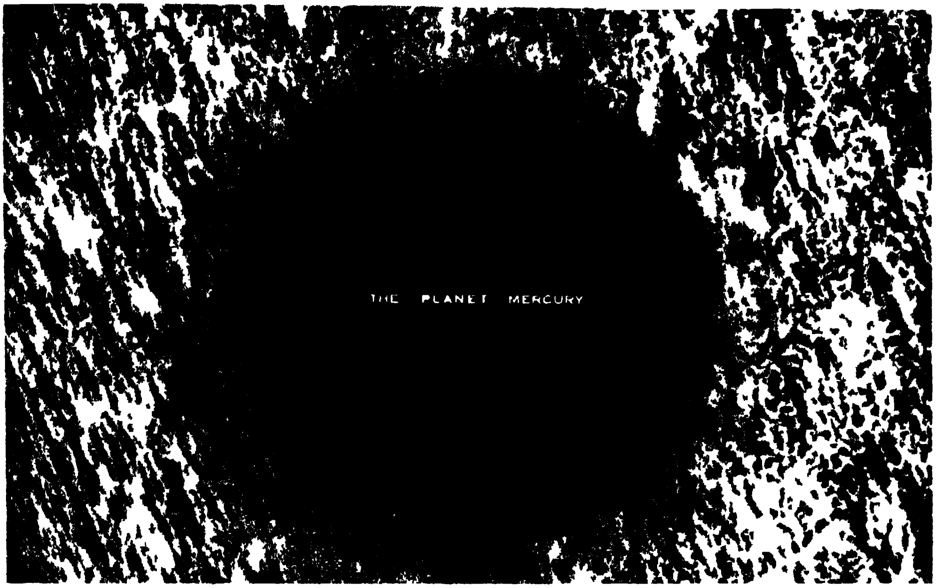
HEIGHTS OF THE LUNAR MOUNTAINS

A comparison between the heights of some of the lunar mountains and those on the Earth Considering the small size of our satellite, her mountains are comparatively much higher than terrestrial mountains.

PLANETS, COMETS AND METEORS



THE SMALLEST PLANET

Mercury is a planet of which we know very little. In the first place it is the nearest to the Sun of all the family of planets; in the second it is very small; and in the third it is never above the horizon for more than two hours after sunset or the same time before sunrise, and is therefore very difficult to observe. It shines with a rose-coloured light, has no spots and no moon. Here we see it crossing the disc of the Sun or "in transit" as it is called.

NOT only is Mercury the smallest planet but, so far as we know, it is the nearest planet to the Sun, receiving from it the greatest amount of light and heat. A hundred years ago astronomers believed that there might be another planet nearer to the Sun than Mercury, and in 1859 one of them stated that he had actually observed an object that he thought was this new planet. To it the name Vulcan was given, but, although observers have been keenly on the look-out for it, this new planet has never been seen. It seems scarcely likely that such a planet can exist and that it would have remained undetected when hundreds of astronomers scan the sky every day.

Nevertheless, there exists the possibility of a new planet being discovered. Until 1930 the number of known planets was eight, but in that year an astronomer at Lowell Observatory in the U.S.A. discovered one at a greater distance from the Sun than any of the others. The new planet was named Pluto and it was calculated that it takes 248 years to complete its circuit of the Sun. The planet nearest the Sun, Mercury, takes only 88 days, while the Earth, of course, takes one year.

The Greeks and Mercury

Mercury is a somewhat difficult object to be seen with the naked eye for two reasons—it is so small and it is so near to the Sun. The best time to look for it is either just before sunrise

THE CLOUDY PLANET

Venus when seen through a telescope shows phases as does our Moon Its surface is extremely brilliant, being covered with cloud or vapour which reflects the rays of the Sun and baffles all attempts to discover the nature of the planet's surface

in September or October or just after sunset in March or April. At those times it is at a point in its orbit when we see it at its greatest distance from the Sun.

In spite of the fact that it is so difficult to observe, Mercury was well-known to the ancients. There is a record of its observation in 264 B.C., but even before this the astronomers of Nineveh allude to Mercury in a report that they made to Ashurbanipal, King of Assyria.

The Greeks did not know that Mercury could be seen either in the evening sky or in the morning sky, according to its position in its orbit. They thought that the two appearances were those of different planets and so they had two names for it—"Apollo," when it was a morning star, and "Mercury" when seen in the evening. Although Copernicus knew of the existence of Mercury it is said that he never actually saw it.

In the telescope Mercury is not a very interesting object. It is apparently surrounded by a dense envelope of clouds that reflect the sunlight and prevent us seeing clearly to the surface below. Occasionally shady markings have been seen, however, but generally speaking little is known about the planet. Its mean distance from the sun is about 35,950,000 miles, but it has a very eccentric orbit and at times may be 7,400,000 miles nearer or further away. It revolves around the Sun in eighty-eight days and has a diameter of about 3,100 miles.

Phases of Mercury and Venus

We must mention that in a telescope both Mercury and Venus show phases exactly as the Moon does. They may be seen at quarter, half, or full, and their phases depend entirely on the positions of the planets in their orbits in regard to the Sun and the Earth. When either Mercury or Venus is passing on our side of the Sun, and when the Earth, the planet, and the Sun are in line, the planet is said to be in "inferior conjunction." When the planet is on the other side of the Sun, however, and in line with the Sun and the Earth, it is said to be in "superior conjunction." It is when at this latter part of their orbits that either of the planets would present a circular outline (as does the Moon when "full"), but on these occasions they are invisible, of course, owing to their being behind the Sun.

VENUS—THE EARTH'S "SISTER PLANET"

VENUS is very different from Mercury in many ways. At times she is so brilliant that she may be seen by daylight, whilst when darkness falls she attracts the

attention of everyone. When Venus appears in the evening sky after sunset she is sometimes called "the evening star." Should it so happen that she appears near Christmas time, there are generally "letters to the newspapers" from people who think they have seen the star of Bethlehem again!

The Greeks Knew Venus

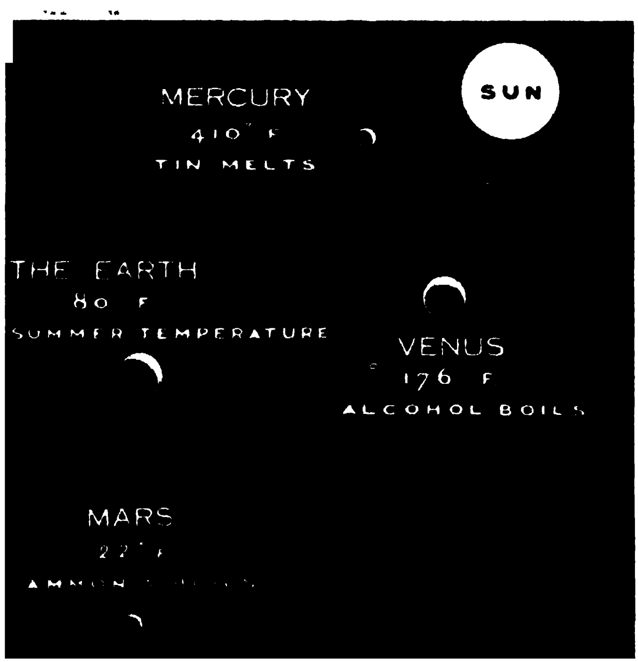
Venus was known and admired in the earliest times and is supposed to be the "Mazzaroth" mentioned in the Book of Job. As in the case of Mercury, the Greeks had two names for Venus—"Phosphorus" for the morning star and "Hesperus" for the evening star. Pythagoras was the first to point out that the morning and evening appearances were not due to two planets but to the same planet in different positions in its orbit.

As we have already mentioned when dealing with Mercury, Venus shows herself in phases. Galileo was the first to discover these phases and announced his discovery in an anagram to his friend Kepler.

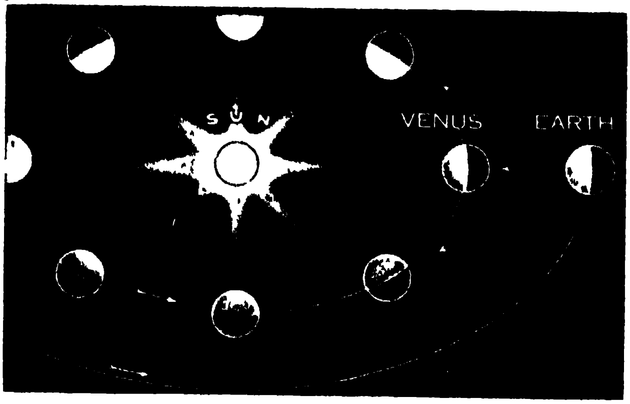
An anagram is a re-arrangement of the letters in a given sentence. In those days this was a popular method of announcing discoveries, for after publication it allowed a certain amount of leisure in which the discovery might be verified before the clue to the interpretation was given. Should anyone else make the same discovery in the meantime it only became necessary for the original discoverer to translate his anagram to show that he was first in the field. Thus it came about that Galileo published this peculiar sentence in Latin: *Hæc immatura a me iam frustra leguntur: o y* Some months later by moving the letters to their correct places he gave the solution, which was: *Cynthiæ figuras æmulatur Mater Amorum*, meaning "Venus imitates the phases of the Moon."

Rotation Period

In the telescope, Venus is somewhat disappointing, for her great brilliance makes the detection of markings a somewhat difficult matter. Faint and badly defined spots and shadings have been seen, however, and from their



This diagram suggests that the Earth may be the only planet on which life as we know it is likely to exist. Mercury and Venus are too hot, while Mars, with an average temperature of 10° below freezing point, is too cold. In the case of Mercury and Venus, of course, these conditions may be mitigated to a certain extent by the envelope of clouds that surrounds them.



WHEN VENUS COMES NEAREST

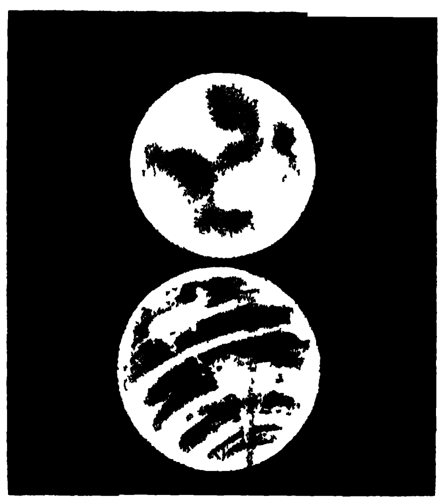
Venus travels round the Sun at a distance of about 67 million miles, and at times its course brings it within 40 million miles of the Earth. Unfortunately when at its nearest point the planet turns its dark hemisphere towards us so that we can see nothing of it

appearance it would seem that Venus possesses high mountains. The absence of definite markings has made it difficult for us to learn how long Venus takes to rotate on her axis. In the seventeenth century Cassini came to the conclusion that the period was about twenty-three hours, and subsequent observers confirmed this period. On the other hand, Schiaparelli—the discoverer of the canals on Mars—decided that Venus required not hours but months to complete a rotation. Other observers have confirmed this opinion. Thus, we come to the conclusion that we do not know for certain what is the planet's rotation period, and must wait for more definite information.

That Venus has an atmosphere is beyond doubt, but we may conclude that it is less dense than the Earth's atmosphere. Even though there is air on Venus it is by no means certain there will be life there. Under some conditions life might exist—as it might even on Mercury—for the greater heat owing to its nearness to the Sun might, to a certain extent, be tempered by a thick envelope of clouds. On this point we cannot speak with certainty.

If there are any people on Venus they should be able to see the Earth, which will appear to them to be far brighter than Venus appears to us. They will see, too, our Moon close to the Earth and passing through her phases — a beautiful and interesting spectacle.

The distance of Venus from the Sun is about 67,000,000 miles, and she receives almost double the amount of heat and light that the Earth does. She revolves around the Sun in 225 days, or nearly 7½ months, and her diameter is about 7,700 miles. She is therefore only a little less in size than the Earth, and for this reason is sometimes spoken of as being the Earth's "sister planet."



VENUS AND THE EARTH COMPARED

There is very little difference in size between Venus and the Earth, for the diameter of Venus is 7,700 miles. In shape the difference is considerable, however, for the Earth is flattened at the poles, whilst Venus shows no flattening and is a perfect sphere.

THE PHASES OF VENUS

While the Moon passes through its phases from new to full in 28 days Venus passes through her phases much more slowly. A study of the dates printed under these drawings gives proof of this. The spectroscope shows us that the cloud surface of Venus rotates once in 20 days but the clouds are 80 miles thick and it is probable that the planet itself revolves more rapidly.

Transits of Venus

Sometimes Mercury or Venus may pass directly between the Earth and the Sun, an occurrence that is known as a transit. On such an occasion the planet is seen as a round black spot against the Sun's disc. Transits of Venus are more rare than those of Mercury, and they are of greater importance. In 1679 Halley pointed out that observations of the transits of 1761 and 1769 could be used to calculate the distance of the Sun. The transit of 1761 was observed from different parts of the world, but certain discrepancies in the observations caused the results to be unsatisfactory. The observations of the 1769 transit were of great value, however, the event being observed by several expeditions one of which was despatched by George the Third at his own expense to Haiti. The next transit of Venus will not take place until the year 2004.

MARS, THE "RUDDY PLANET"

MARS, the fourth planet in order of distance from the Sun, is 4,215 miles in diameter. It completes a revolution of the Sun in 687 days, and rotates on its axis in twenty-four hours thirty-seven minutes. Consequently the seasons on Mars are about twice as long as on the Earth, but day and night on the planet are only a little longer.

Although Galileo examined Mars with his telescope he was unable to discover anything of importance. A Dutch astronomer named Huyghens who lived in the seventeenth century, was more fortunate, however, and saw dark markings. Since that time Mars has been closely studied by many astronomers, and so complete a knowledge has been gained of the planet's surface markings that maps and even globes have been constructed with each Martian feature depicted and named thereon.

Ellison Hawks

ICE AND SNOW AT THE POLES OF MARS

Here we see the South Polar cap surrounded by a dark ring of water from the melting crown. (See illustration on next page.)

Canals on Mars

In 1877 Schiaparelli of Milan announced that he had discovered a network of fine lines, some of which extended for hundreds of miles across the planet's surface. Although he called these lines "canals," Schiaparelli had no thought that they might be canals in the strict sense of the word—that is to to say, artificial waterways made by intelligent beings. The peculiar markings have been seen by many other observers, and some have noticed that at places where they cross each other there are generally dark round spots, which are called "oases."

The late Professor Lowell, who erected an observatory in Arizona specially to study Mars, advanced a theory that the "canals" are actually artificial waterways constructed by the inhabitants of Mars. He pointed out that Mars has a very thin atmosphere and that clouds are rarely seen.

The absence of clouds means that there would be no rain, and no rain means no rivers. The question of water supply on Mars therefore is a very different thing from what it is on the Earth. If there is intelligent life there, Lowell argued, it is reasonable to suppose that the inhabitants exist on the produce of the land. Now, the only water available on the planet is locked up in the ice and snow of the polar caps. When the Martian summer advances and the ice and snow melts, the inhabitants bring the water from the polar regions to the desert areas by means of the canals that they have constructed.

The dark spots at the junction of the canals are believed to be

The Polar Caps of Mars

Even to the naked eye Mars appears to shine with a ruddy hue, and the telescope shows that this is due to the fact that as a whole the planet is orange-coloured. It is as though we were looking at a great area of golden sand, and this is believed to be actually the case. At the poles there are patches of brilliant white, which do not remain of a uniform size. They increase as spring advances on the planet, and decrease until by the end of the Martian summer they have almost disappeared. These polar caps may be vast fields of ice and snow surrounding the polar regions of Mars and resembling the Arctic and Antarctic regions on the Earth.

We have already mentioned certain dark markings, and at one time these were thought to be oceans or seas. It is now certain that they are not water, however, but that they are probably areas of vegetation, which spring into life when the water from the melting polar caps reaches them.

centres of habitation, their dark appearance being caused by the growth of vegetation watered by the canals. Whether or not Lowell was right we do not know—it remains to be seen what the future will teach us.

The Satellites of Mars

Mars has two small satellites named Deimos and Phobos, which are the mythological names of the horses that drew the chariot of Mars. These two moons are very small, Deimos being only about 10 and Phobos about 35 miles in diameter. Their orbits are comparatively close to Mars, that of Deimos being 14,600 miles, and Phobos 5,826 miles distant from the planet. Deimos completes a revolution of Mars in 30 hours 18 minutes, whilst Phobos moves more rapidly requiring only 7 hours and 39 minutes to complete a revolution.

In the case of Phobos, we have a curious state of affairs, for the satellite revolves around Mars in less time than it takes the planet to complete a revolution on its axis. As we have already seen, Mars requires 24 hours 37 minutes to complete one revolution, so that Phobos revolves around it more than three times in one Martian day! As it travels more quickly than the planet rotates, it will not rise in the east and set in the west as our Moon does but will rise in the west and cross the heavens 2½ times in a Martian day, setting each time in the east!

THE MINOR PLANETS

MERCURY, Venus, the Earth and Mars are sometimes called the "inferior planets," and the four planets beyond Mars—about which we shall read later—are called the "superior planets." The ancients knew only six planets; Uranus was not discovered until 1781, Neptune in 1846, and Pluto in 1930.

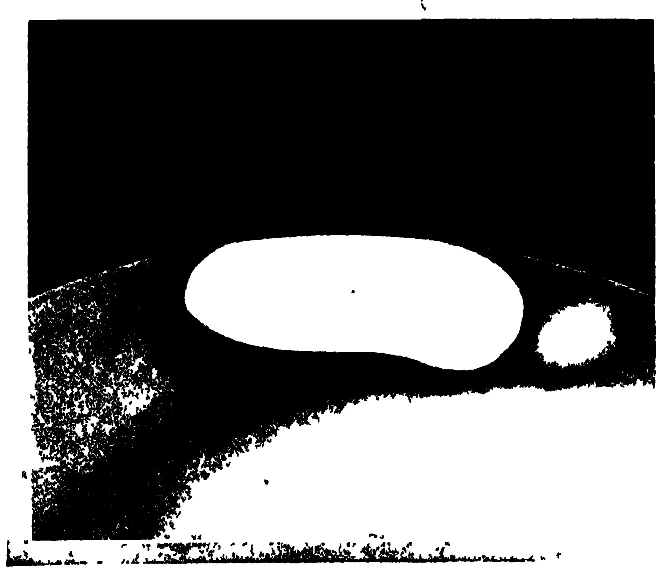
A Curious "Law" of Progression

Between the orbits of Mars and Jupiter is a space in which there are a large number of interesting little bodies—the Asteroids, or "star-like" planets. The discovery of these asteroids came about in a remarkable manner. In 1772, a German astronomer named Bode noticed that a curious relationship existed between certain figures and the distances of the planets from the Sun, and this relationship is now called "Bodes' Law." If we write down certain figures of which each but the first and second is double that of the number preceding it, we get:

0, 3, 6, 12, 24, 48, 96, 192, 384;

adding 4 to each number gives:

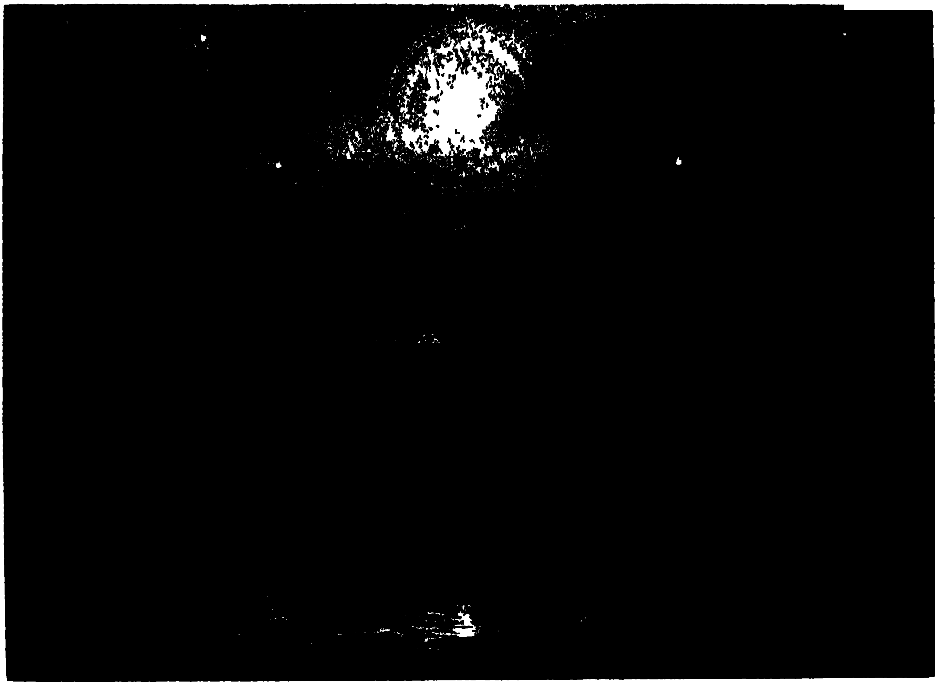
4, 7, 10, 16, 28, 52, 100, 196, 388.



Wilson Hawks.

CHANGES IN THE SOUTH POLAR CAP

This drawing was made some weeks after the one on the previous page, and in the interval a considerable part of the snowfield has melted.



THE EARTH AS SEEN FROM VENUS

If there are people on Venus they may occasionally catch a glimpse of Earth through the surrounding mists. This picture shows how our planet may look if seen from Venus. The Earth would be a specially brilliant object in the night sky of Venus, because that planet has no moon. The rings around the Earth are of atmospheric origin and are caused by refraction.

It is strange to find that these latter numbers represent fairly accurately the distances of the planets from the Sun, expressed in ratio of the Earth's orbit. This is shown more clearly by the following table:

Planet.	True Distance from the Sun.	Distance as shown by "Bode's Law."
*Mercury	3·87	4
*Venus	7·23	7
*Earth	10·00	10
*Mars	15·23	16
Asteroids	27·66	28
*Jupiter	52·03	52
*Saturn	95·39	100
Uranus	191·83	196
Neptune	300·37	388

At the time Bode made his interesting discovery, only the planets marked * in the above table were known, but the discovery of Uranus in 1781, at a distance that corresponded to that shown by the "law," greatly strengthened belief in it. The blank between the orbits of Mars and Jupiter was noticed, and as Kepler had predicted that some small planets would be found in this zone, astronomers began seriously to consider the matter. In 1800, Baron von Zach called a conference at Lilienthal and each astronomer present agreed to combine with others in examining the sky, in the attempt to discover these small planets that were believed to exist. The astronomers named themselves the "celestial police," and they "patrolled their beats" each night with the aid of their telescopes.

The "Celestial Police" make Discoveries

At Palermo, in Sicily, is an observatory, the director of which at the time was Piazzi. He had actually been appointed one of the "celestial police," but he did not know the arrangements that had been made in this connection by the conference. Piazzi was engaged in making a catalogue of stars, and on the first night of the nineteenth century (1st January, 1801) he charted the position of what he took to be a star. On several evenings he noted this object, but, much to his surprise, he saw that it was moving among the stars. At first he thought that the new body was a comet, but soon it became evident to him that a new planet had been found. When his observations were completed it was seen that this new planet revolved in an orbit that lay between Mars and Jupiter, and it therefore filled the blank space where—according to Bode—a planet should be found.

The new planet was named Ceres, after the patron goddess of Sicily. Although a very small object—it is only about 447 miles in diameter—it fulfilled the necessary conditions and once more the Solar System was regarded as being complete.

Shortly afterwards, however, Olbers, a German astronomer and another member of the "celestial police," discovered (in 1802) another small object. This turned out to be a second planet, and to it the name of Pallas was given. The discovery of this second planet caused much astonishment in the scientific world, and many theories were put forward to account for the two tiny planets. The "celestial police" became more enthusiastic than ever, thinking—doubtless—that if there were two of these tiny planets, there might easily be more. They "patrolled" the heavens more keenly than ever, and it was not long before their vigilance was rewarded, for two more planets

COMPARATIVE SIZES OF THE EARTH AND MARS

Mars is 4,215 miles in diameter, and is therefore approximately half the diameter of the Earth. It rotates on its axis in 24 hours 37 minutes and completes a revolution of the sun in 687 days.

were discovered—one in 1804 and the other in 1807.

It was suggested that these four planets were fragments of some larger planet that had at some remote date been blown to pieces. For many years this theory held the field, and although at one time it was supposed to be impossible, it has been revived in recent years, as we shall mention later.

The Amazing Number of Asteroids

Although the search was still carried on after the discovery of the fourth planet, it was abandoned in 1816, for no more discoveries had been made. Fourteen years later, however, a German amateur commenced a search, which he continued for fifteen years, when his patience was rewarded by the discovery (in 1845) of a fifth planet. Eighteen months later he found another, and two more were found in the same year (1847) by an English astronomer. Since that time there has been a continual record of discoveries, not a year having passed without from one to a hundred having been discovered. Now, over 1,000 of these minor planets have been recorded and their orbits calculated. Over 500 more have been discovered but lost again because not enough observations could be made to enable their orbits to be calculated.

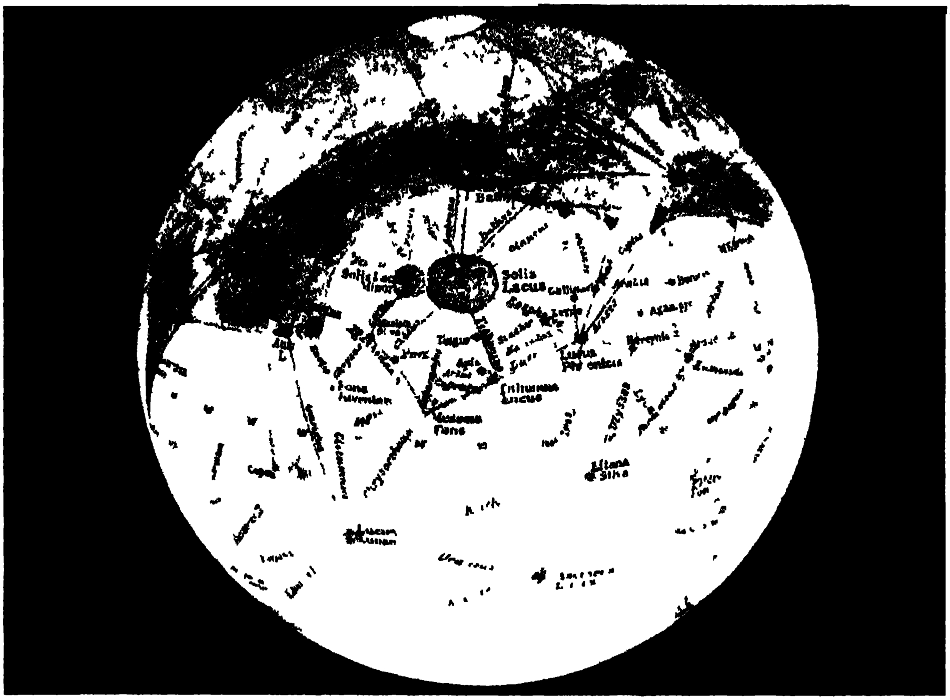
The earlier minor planets were given names, but when it was evident that there was a large number of them, it became the practice to distinguish them by a letter of the alphabet. When all the letters were used up, the alphabet was used again as a combination of two letters, something after the style of motor car registration in our large cities. Thus, the members of the first series were known as A, B, C, etc., the second were AA, AB, AC, etc. Then came BA, BB, BC, followed by CA, CB, CC, etc., and so on.

The Importance of Eros

Of all the hundreds of asteroids, the most important and interesting is the one labelled DQ, and also named Eros. It was discovered in 1898, and is probably only about 15 miles in diameter. Its special interest is due to the fact that the greater part of its orbit lies within that of Mars. At certain favourable times — once every thirty-seven years—it comes as close as within 13,840,000 miles of the Earth. With the exception of the Moon, therefore, Eros comes nearer to us than any other heavenly body. Its parallax has given us a means of revising our measurements of celestial distances, and the whole scale of the Solar System has been re-calculated by the aid of tiny Eros.

THE CLOUDS OF VENUS

If you could hover above Venus, all you would see would be a vast plain of pearly clouds shining under the fierce rays of the Sun. This envelope of clouds is probably 80 miles in thickness, and no doubt does much to protect the surface from the tremendous heat and glare.



Ellison Hawks

THE "CANALS" OF MARS

The thin atmosphere of Mars, and the total absence of clouds, enables us easily to see the surface of the planet with our telescopes. The planet is covered with long straight lines and some astronomers think these may be canals planned by the inhabitants of Mars to irrigate the Martian deserts, the canals being fed from the snows of the polar caps, which melt in summer.

As to the origin of the asteroids we have already mentioned the theory that they represent the fragments of some large planet that exploded. It was thought that the great differences and intersections of their orbits could not be accounted for by any explosion, and that a more probable explanation was that the asteroids were due to a planet that was not properly made. More recent researches seem to suggest, however, that perhaps after all the explosion theory may be correct, and that the present tangle of orbits may be accounted for by the attraction of the great neighbouring planet Jupiter.

JUPITER, THE GIANT PLANET

JUPITER is over 86,000 miles in diameter, and is therefore nearly eleven times as large as the Earth. Although in volume the giant planet is equal to about 1,312 Earths, its mass is so small that, were we to weigh it in a pair of huge scales, only 317 Earths would be required to balance it. Jupiter is situated some 483,000,000 miles away from the Sun, and it completes a revolution of the Sun in just under twelve years.

The Cloud Belts

Jupiter is a most fascinating object in the telescope, and even a small instrument will show much of interest. The planet itself is surrounded by an envelope of clouds, and we are not able to see below them. These clouds lie in light and dark belts parallel to the planet's equator. The clouds are in a constant state of change—sometimes only two or three broad belts are

to be seen while at others eight, ten, or even twelve narrow belts are visible The clouds of which they are composed may remain in existence for days, weeks, or even months As Jupiter rotates on its axis in less than ten hours, there is a constant panorama, as it were, moving before the eyes of the observer

The Great Red Spot

Although the details of the cloud belts are in a constant state of change, there is one marking that seems to be of a more permanent nature This is the Great Red Spot, an oval-shaped object to be seen in the southern hemisphere and situated in a kind of bay called the " Hollow "

It is believed that the Red Spot was observed in 1665, since which date it has sometimes faded or even disappeared, but always to re-appear at a later date It appeared and vanished eight times between 1665 and 1708, after which it remained visible for five years In 1878 it was described as being of a "full red brick colour," and was measured as being 30,000 miles in length and 7,000 miles in breadth Four years later its colour began to fade, and since that date it has sometimes been so faint as to be scarcely visible, at other times it has been seen without difficulty even with comparatively small telescopes

When the Red Spot was first seen it was suggested that it might be the mouth of some huge volcano on the surface of Jupiter, and that this volcano was so high that it reared above the dense envelope of clouds surrounding the planet This theory was rejected after numerous observations had been made, however, for it was found that the rotation period of the spot changes, so that it must have a motion of its own and cannot therefore be attached to the planet beneath It is now thought that perhaps the Spot is a new satellite in the process of formation

We have mentioned that the rotation period of Jupiter is under 10 hours As a matter of fact, the different cloud belts have different rotation periods, some travelling faster than others Generally speaking, the times are beween 9 hrs 55 mins and 9 hrs 56 mins, the latter period relating to the clouds in the equatorial zone These varying rotation periods result in an ever changing appearance, for the quicker-moving clouds overtake others in another latitude, giving the interested observer plenty of work in charting and recording their movements

MARS THROUGH THE TELESCOPE

This is Mars seen through a fairly powerful telescope on October 12th 1909 The white marking on the top of the disc is the South Polar Cap Some of the so called canals can also be seen At the centre is an oasis named *Solis Lacus* or Lake of the Sun

Galileo and the Satellites

We have already mentioned that when (in 1610) Galileo turned his telescope to Jupiter he found the planet to be accompanied by four satellites Their discovery occurred at a fortunate moment, for it helped to show that the Copernican theory might be correct

Galileo believed that Jupiter and his satellites gave an unmistakable illustration of the Copernican teaching, and that the planet was, as it were, a model of the Solar System.

His contemporaries were not so easily convinced, however, and when Clavius—one of the leading astronomers of the day—was told of the discovery he said he would not believe it until he had seen it himself. When actually he did see it through the telescope, he expressed the opinion that the glass had been bewitched. Another philosopher—more prudent, perhaps, than Clavius and unwilling to be convinced—refused to look through the telescope lest he might really see the satellites! He died shortly after this incident, and Galileo sarcastically remarked: "I hope he saw the satellites whilst on his way to heaven!"

ANOTHER VIEW OF MARS

This drawing of Mars was made on March 30th, 1903. Here you see the North Polar Cap, and the dark markings which are probably areas of vegetation in the Martian desert.

The four satellites discovered by Galileo can be seen with a small telescope—in fact, a pair of good field glasses will sometimes show them to be present alongside the great planet. Although they have been named—Io, Europa, Ganymede, and Callisto—they are generally referred to by the numbers I., II., III. and IV. Europa is the smallest of the four, being about 2,000 miles in diameter, and Ganymede is the largest, 3,540 miles in diameter.

As in the case of the Earth and all opaque bodies, Jupiter casts a shadow. In the course of their revolutions around Jupiter the satellites sometimes pass through this shadow. When this occurs, they are eclipsed exactly as our Moon is when it passes through the Earth's shadow. The satellites also pass behind Jupiter, when they are said to be "occulted." When they pass in front of his disc they are seen "in transit," and their own tiny shadows are also seen on the cloud belts as little black dots.

In addition to the four Galilean satellites, Jupiter has five others, making nine in all. The eighth satellite, discovered in 1908 at the Royal Observatory, Greenwich, is remarkable in that it revolves in an opposite direction to that generally followed by the other satellites in the Solar System.

SATURN, THE "PLANET WITH THE RINGS"

SATURN is the most beautiful of all the planets—indeed, it may be said that it is the most exquisite object to be seen in the heavens. The planet itself is surrounded by a great system of rings, and in this it is unique, for there is nothing like it to be seen.

Saturn Puzzles the Ancients

Saturn's rings are invisible to the naked eye, and their existence was unsuspected until Galileo turned his telescope to the planet. Even then their true nature could not be determined, and Galileo wrote to Kepler that: "Saturn has an oblong appearance, somewhat like an olive." Later observers, using imperfect telescopes, came to the conclusion that Saturn was

accompanied by two smaller planets, one on each side, and many curious drawings of the planet were made in those early days.

It was not until 1659 that Huyghens came to the conclusion that Saturn was surrounded by a ring, but being somewhat uncertain as to its exact form he announced his discovery in an anagram —a popular method in those days, as we have already mentioned. Three years later Huyghens confirmed his discovery and made known the solution of his anagram. The jumble of letters previously published were arranged to read: "Saturn is surrounded by a thin flat ring, nowhere touching . . ."

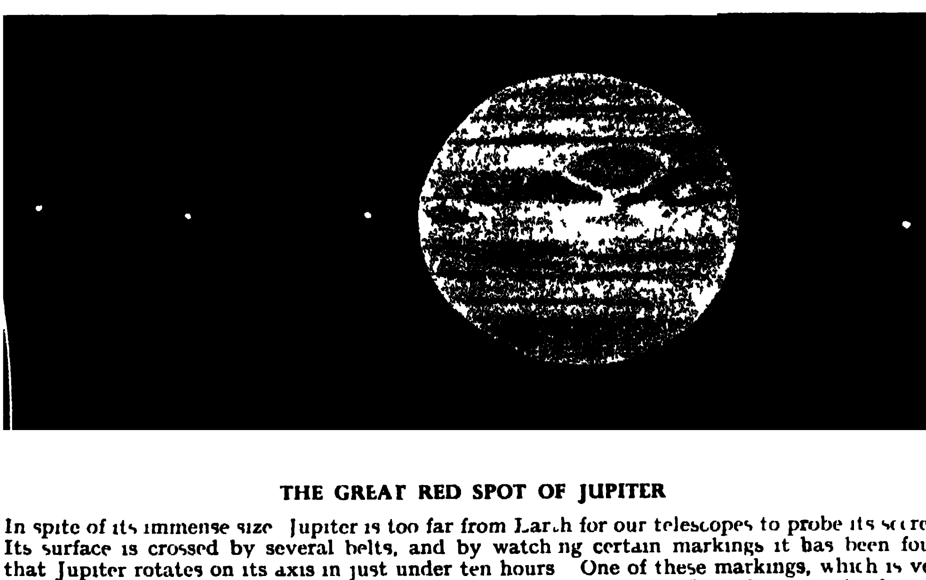
In 1675, Cassini, the French astronomer, found that the ring was divided by a dark rift, which to-day is known as the Cassini division. Another and similar rift in the outside ring was discovered in 1837 by Encke, and is also named after him In the following year Galle noticed a faint ring lying between the bright rings and the globe of Saturn, and the ring is now called the "crape ring," because of its resemblance to that material.

Many measurements have been made of the rings, but it has been difficult to arrive at accurate results, owing to their extreme delicacy. The generally accepted figures are 171,000 miles for the diameter and 29,000 miles for the width. Their thickness is generally estimated to be about 10 miles.

Changes in the Rings

The rings vary in appearance year by year, owing to the difference in the angle at which we see them. They run through their cycle of changes in 29 years 167 days. When "edgeways" to us they are seen only as a thin needle of light on each side of the planet, whilst on occasion they completely disappear. As time goes on, however, they gradually open out again, until about seven years later they are seen at their widest opening. Once again they commence narrowing, and having passed through the "edgeways" stage open out so that we then see their under side, as it were.

These changes puzzled the early observers, who could not understand why sometimes Saturn appeared "like an olive" and at other times had a



THE GREAT RED SPOT OF JUPITER

In spite of its immense size Jupiter is too far from Earth for our telescopes to probe its secrets Its surface is crossed by several belts, and by watching certain markings it has been found that Jupiter rotates on its axis in just under ten hours One of these markings, which is very persistent, is of a reddish colour, and is called the Great Red Spot It is shown in the drawing above, a little to the right of the centre of the planet

THE GREATEST PLANET

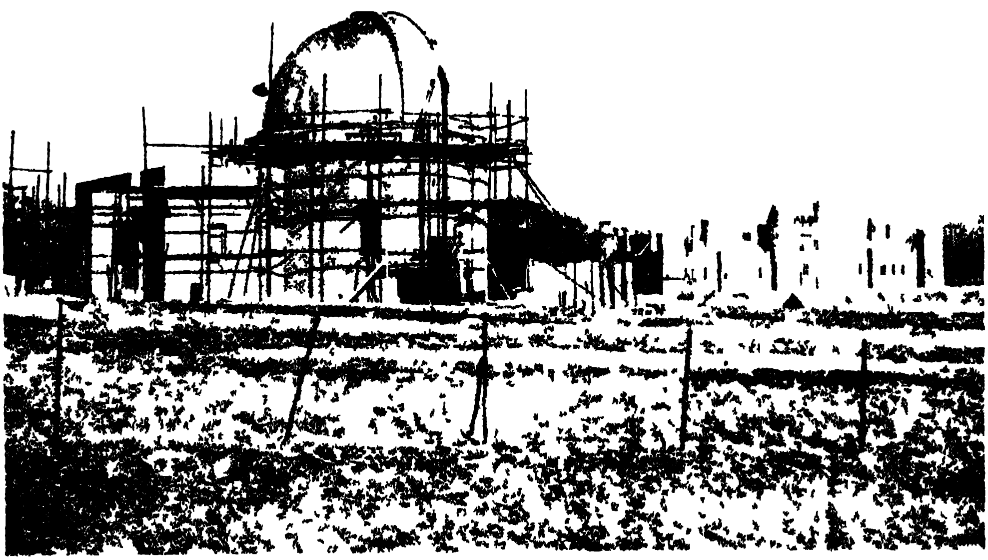
Although its size is 1,300 times that of Earth, the weight of Jupiter is only 300 times that of our planet. This shows that the Giant Planet is still in a nebulous (cloudy) condition, and that millions of years must elapse before it is in a similar condition to that of the Earth to-day. You will notice that Jupiter is flattened at the poles owing, no doubt, to the speed at which it revolves on its own axis. The puzzle of Jupiter is the Great Red Spot, which has been visible for over 250 years. It is 30,000 miles long and 7,000 miles wide.

round and normal appearance. A year and a half after Galileo had noted the "oblong appearance," he found to his consternation that it had disappeared and that Saturn appeared only as a slightly oval globe. The change troubled him greatly, for it made him almost believe that he had been mistaken in his earlier observations. "Were the appearances indeed an illusion and a fraud?" he asked. "Has the glass so long deceived me, as well as many others to whom I have showed them . . .? I do not know what to say in a case so strange, so unlooked for, and so novel." And we can well picture the great astronomer's anxiety, for such a unique appendage as Saturn's ring system would be most difficult to imagine.

What the Rings Are

There have been many speculations as to the actual composition of the rings. It was proved that they could be neither solid nor liquid. Clerk Maxwell, the famous mathematician who predicted the discovery of the Hertzian waves, suggested that the rings could only consist of a multitude of small particles, and this has since been shown to be the fact.

By means of that wonderful instrument the spectroscope, Professor Keeler, of the Lick Observatory, showed that the rings are composed of numbers of tiny satellites, each revolving in its own orbit around Saturn. They are so small and so far away from us as to be indistinguishable from each other even in our largest telescopes. The dark rifts are

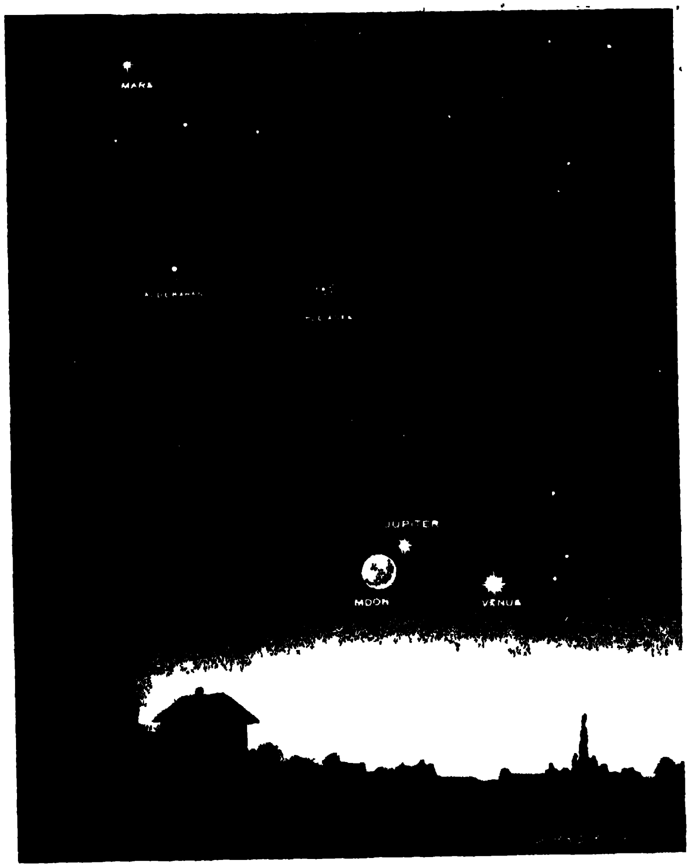


HERSTMONCEUX CASTLE, NEW HOME OF ROYAL GREENWICH OBSERVATORY

The Royal Observatory was established at Greenwich by King Charles II in 1675, and when the nations agreed in 1884 to establish a zero or prime meridian from which the longitudes of all other places should be measured, Greenwich was chosen in recognition of the part played by the Observatory in astronomical and nautical science. Owing to its proximity to London there has been a steady deterioration in conditions for observation and it was eventually decided to remove the Observatory to Herstmonceux Castle, Sussex. In the photograph above the work of converting the Castle to its new use is in progress. When the removal is finally completed it will be known as the Royal Greenwich Observatory.

caused by the absence of satellites in those particular regions, and the crape ring is accounted for by the fact that here the satellites are fewer in number.

Saturn has ten satellites in addition to the millions of tiny moons that form the rings. Each satellite is named, and the largest is Titan, which is about the size of Mercury. The faintest satellite is Themis, and, as in the case of the eighth satellite of Jupiter, it has never actually been seen by the human eye. We depend on the photographic plate for a record of its whereabouts. Phœbe, the outermost satellite of the system, also resembles Jupiter's eighth satellite in the fact that its movement around Saturn is retrograde—that is, opposite in direction to that of the other satellites in the Solar System. It requires 550 days to complete one revolution of Saturn.



A RARE AND BEAUTIFUL SIGHT

On March 14th 1929, a sight of great interest to astronomers was seen in the western sky. Venus, Jupiter and Mars were all in conjunction with the Moon. Venus was at her brightest, shining with silvery brilliance. Jupiter larger but less brilliant, had a primrose hue, while Mars higher in the sky, shone with its familiar ruddy colour. The first magnitude star Aldebaran and the wonderful group the Pleiades were below Mars.

Saturn's distance from the Sun is 885,900,000 miles, which varies by nearly 100,000,000 miles owing to the eccentricity of its orbit. At its nearest, it is 745,000,000 miles distant from the Earth. It requires 29½ years to complete a revolution of the Sun. The planet is 73,713 miles in diameter—just over nine times that of the Earth.

URANUS, HERSCHEL'S PLANET

To the ancients, Saturn was the outermost planet, and until 1781 it was believed that the Solar System was complete with the six planets already known. But in that year a seventh planet was discovered by William Herschel, in circumstances that are as interesting as they are romantic.

A Musician Becomes an Astronomer

Herschel, who was born in Hanover on the 15th November, 1738, was a

member of the band of the Hanoverian Guards at the early age of fourteen. When the French invaded Hanover at the beginning of the Seven Years' War, Herschel's regiment was among the defeated at the Battle of Hastenbeck. Although not wounded, the fact that he had to spend a night in a ditch, together with other discomforts that invariably accompany campaigning, led Herschel to decide to change his profession. He deserted and escaped to England, where he arrived with only a French crown piece in his pocket.

He soon gained a reputation as a musician, however, and by 1766 he was a member of the Pump Room Orchestra at Bath. Later, he was appointed organist at the Octagon Chapel and became a concert director at Bath, which in those days was the resort of fashion, beauty and the talents.

Herschel was naturally of a studious disposition, and he spent every spare moment in endeavouring to learn more about music. He took up the study of mathematics in order to go further into the theory of music, following this with optics and astronomy, both of which subjects are closely connected with mathematics.

He was greatly interested in reading about the wonders of the heavens, and he made up his mind that he would have a telescope so that he might see these wonders for himself. He managed to procure a small telescope, and was so thrilled with what he saw with it that he determined to have a more powerful instrument. The price of such a telescope was more than he could afford, however, so he set to work to make one himself. He succeeded in making a large telescope that was of very good quality, and this was the first of many instruments that he made. Indeed, such was his mastery of the art that his name soon became known throughout the world as a maker of fine telescopes and subsequently he received many orders from foreign potentates and princes.

Herschel Discovers a New Planet

He continued improving his instruments and making observations until 1781, when he commenced to review the heavens and to examine all the stars above a certain magnitude. On the 13th March, 1781, he was engaged in these observations when he noticed an object that appeared to be quite different from the stars with which he was familiar. We must here explain that when seen through a telescope a planet shows a tiny disc, whilst a star

SATURN, THE RINGED PLANET

Second in size to Jupiter, Saturn is 745 times greater than the Earth, but only 90 times heavier. Its disc carries cloud belts, similar to those of Jupiter, but it has what no other planet possesses an immense system of rings. In this drawing the rings are seen edgeways, and are so thin that from this aspect they are almost invisible.

..I THE PLANET'S SHADOW

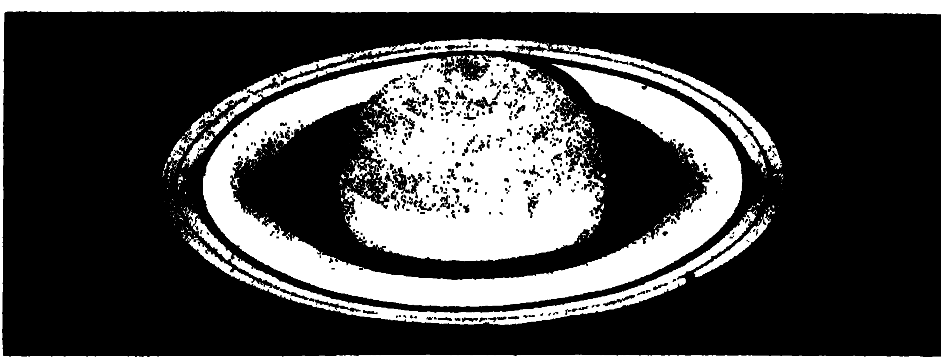
In this second view of Saturn the rings are plainly seen. It will be noticed that there are three separate rings, the two outermost being bright like the planet itself, while the inner is dusky and is known as the Crape Ring. Notice, too, the shadow of the planet on the rings, at the left-hand side of the globe.

is visible only as a point of light. To a less careful observer, the object that had aroused Herschel's curiosity might easily have been mistaken for a star, but he saw at once that it presented a small but distinct disc.

At first he thought he had discovered a comet, but as he watched it night after night he noticed that it changed its position in regard to the neighbouring stars. After several observations had been made it became possible to calculate its orbit, from the shape of which it was apparent that the object could be nothing else but a new planet.

We can imagine what great excitement there was when the discovery was announced. Herschel's name was in everyone's mouth, and he was commanded to appear before the King to give an account of his work. His Majesty was so delighted that he appointed Herschel Astronomer Royal, so that he was no longer dependent on music for his living.

Although Herschel suggested that the new planet should be named the Georgian Star as an honour to the King, it was eventually christened Uranus. After all, this is perhaps a



THE RINGS FULLY OPENED

Saturn's rings are believed to consist of an enormous number of small satellites revolving around the planet. Here they are seen opened to their full extent. Saturn also has no fewer than ten moons, the largest of which is almost equal in size to the planet Mars.

more suitable name, for it is the title of the mythological father of Saturn and grandfather of Jupiter. As Uranus comes next to Saturn and next but one to Jupiter in order of distance from the Sun, the name is entirely appropriate.

Uranus is over 1,782,000,000 miles distant from the Sun, and requires 84 years to complete one revolution of its orbit. It is about 32,400 miles in diameter and rotates on its axis in 10¾ hours. It can only be seen by the naked eye on favourable occasions, and even in a powerful telescope it has little interest for the observer. It has four satellites, two of which were discovered by Herschel, the third and fourth being discovered in 1851. The satellites are remarkable for the fact that they revolve around Uranus in orbits at right-angles to those of the satellites of the other planets of the Solar System. That is to say, instead of revolving from west to east around the planet, they move almost north and south.

various forces that affect a planet's movements.

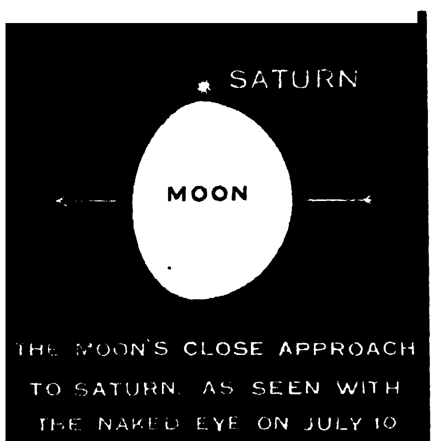
The Effects of Gravitation

Kepler showed that the time required by a planet to complete a revolution of its orbit depends on its distance from the Sun. This was followed by Newton's proof that the movements of the planets were due to gravitation. He made it clear that every body of matter attracts every other body with a force that depends, firstly on the masses of the bodies, and secondly on the distance separating them.

Knowing this, we can quite understand that not only are the planets attracted by the Sun, but that they also attract one another. Of course, the Sun exercises an infinitely greater attraction on the planets because of his huge mass, but the fact remains that the planets themselves do exercise a measurable influence on each other.

NEPTUNE AND PLUTO

THE discovery of Neptune, the planet beyond Uranus and, until the discovery of Pluto, the outermost planet in the Solar System, was a veritable "triumph of mind over matter," for the planet was found on paper before it was ever seen with the telescope! To understand exactly how this was possible we must first explain about the



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SATURN IN CONJUNCTION WITH THE MOON

On the night of July 10th, 1927, the very rare sight was seen of the planet Saturn in conjunction with the Moon, that is, the two were in a line from the Earth. In the telescope the Moon was seen to pass just below the ringed planet.

Knowing the masses and the distances of the planets from the Sun, mathematicians are able to calculate exactly the positions where a planet should be at any given date. When required, these calculations can be made years ahead; and, in fact, every year there is published a kind of astronomical Bradshaw called "The Nautical Almanac," containing numerous details about the future position of the planets.

A Difficult Problem

After the discovery of Uranus its position was carefully measured, and some forty years after it was discovered, Bouvard, a French mathematician, published tables showing its movements. When the predicted positions came to be checked with the actual positions, however, it was found that they did not agree. Bouvard supposed that the observations on which he had made his calculations had not been carefully made, and he prepared new tables based on more recent observations of the planet.

[illegible] Photos

ENGLAND'S BIGGEST TELESCOPE

The most modern telescope in England is the William Johnson Yap, reflector at Greenwich Observatory. Completed in 19[illegible], at a cost of £15,000, it has a 36-inch mirror and weighs altogether some seven tons. This is the largest telescope that can be usefully employed in this country.

After a few years' time observers noticed that there were still differences between the predicted and the actual positions of the planet. These discrepancies caused Bouvard to suggest that perhaps an unknown planet was attracting Uranus and upsetting the calculations. The problem was to find the position of the unknown planet in the sky simply by the errors arising out of the position of Uranus. This promised to be a task of considerable difficulty and one that was likely to take a very long time, but in 1843 J. C. Adams determined to undertake the necessary calculations. For two years he pursued his task, and in October, 1845, took to the Astronomer Royal his papers, which contained the elements of the orbit and the calculated position of the theoretical planet. Unfortunately, the Astronomer Royal paid little attention to the matter, placing the papers in a drawer from which they were not brought out until it was too late.

Neptune Discovered

In the meantime a young French mathematician, named Leverrier, had also been working on the problem, quite unaware of the fact that Adams had already commenced the task. Leverrier worked out the position of the supposed planet and wrote to Encke, the Director of the Berlin Observatory, asking him to search that part of the sky. When Encke received this letter he instructed one of his assistants to commence a search, and on the same evening (the 23rd September, 1846) this observer found an object of about the eighth magnitude that was not shown

on the star map. The same object was observed on subsequent evenings, and as it moved its position each night it was evident that it was the object of the search and a new planet.

In the meantime the Astronomer Royal at Greenwich had received an account of Leverrier's work, and on reading it he remembered the papers that Adams had left in his care some nine months before. Taking them out of the drawer in which he had placed them, he was at once struck with the similarity in the results obtained by the two mathematicians. Remembering that both Adams and Leverrier had been working on the problem unknown to each other, he realised that there was something more than a mere coincidence in the success of the results. He therefore asked Professor Challis, of Cambridge, to search for the new planet, and on the 28th September, Challis found the same object that had already been observed at Berlin a week before.

Neptune's Distance

Thus, Neptune was discovered in England and in France by the two mathematicians before it was seen in a telescope. As everyone knows, Neptune was the God of the Seas, and the name given to this outermost planet is certainly appropriate. Exactly as Neptune was thought to live in the gloom and darkness of the ocean depths, so is the planet that bears his name plunged in the gloom of space. It is over 2,794,000,000 miles distant from the Sun—so far away that details of its surface are invisible to us, and we have no means of telling how long it requires to rotate on its axis. Its diameter is 31,000 miles—nearly four times that of the Earth—and it requires nearly 165 years to complete one revolution of its orbit.

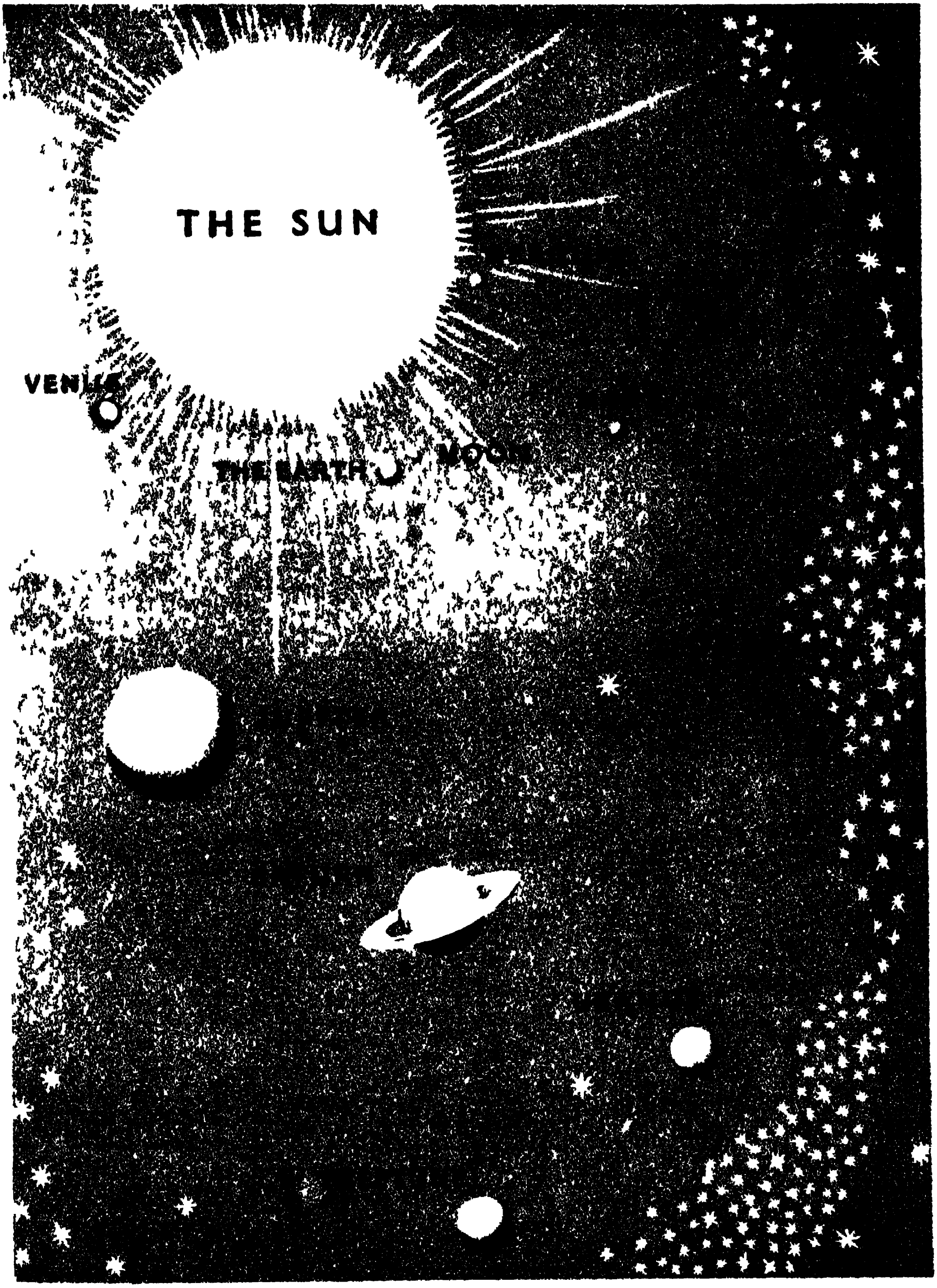
Neptune is so far away from the Sun, that to anyone living on the planet the sun would appear no larger than Venus seems to us, although it certainly would appear immensely brighter. Mercury, Venus, the Earth and Mars would be invisible. So far as we know, Neptune has only one satellite, although there may be others that are invisible to us owing to the great distance. It is one of the largest satellites in the Solar System, its diameter being estimated to be 2,260 miles. Pluto is so far away that it is difficult to make careful observation, but its size and mass are believed to be about the same as those of the Earth or Mars.

SHOOTING STARS, METEORS AND FIREBALLS

OFTEN when we are out on a clear night we see a streak of light suddenly dash across the sky, to disappear as silently as it came. It seems almost as though a mighty star has fallen from its place in the heavens, but if we are anxious about it we can reassure ourselves, for a glance at the constellations shows us that each of our friends is in its accustomed place and none is missing. Few people other than astronomers can bring themselves to believe that these shooting stars are not stars at all, but such is the case, for they have a far more humble origin. As a matter of fact, a shooting star does not actually " shoot " in the heavens but in the Earth's atmosphere, so that it is therefore comparatively close to us. Instead of taking place at a distance that could only be measured in billions of miles the " star " is only some 50 or 100 miles above our heads.

Fireballs and Meteors

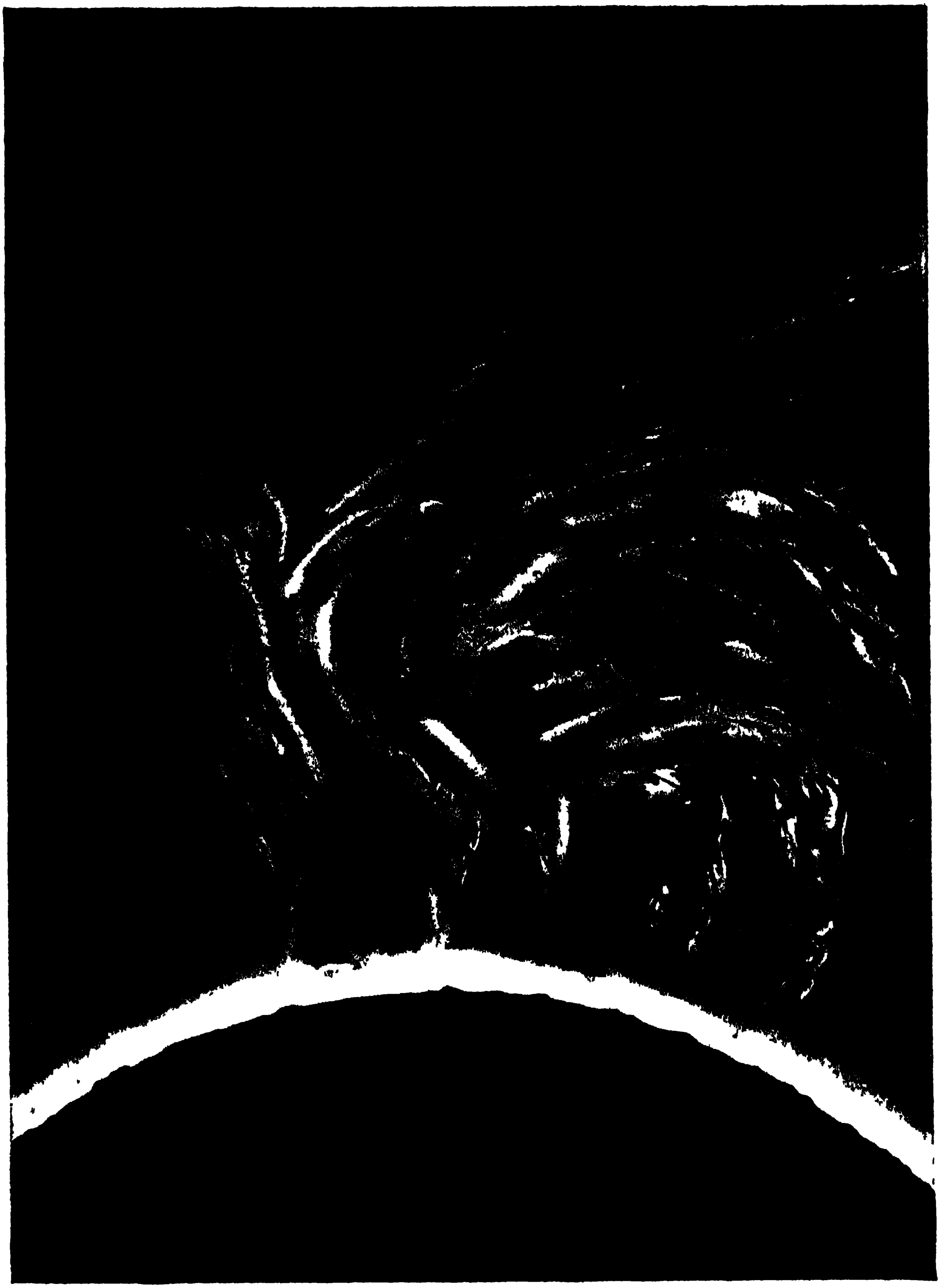
To understand what a shooting star is we must realise that there are multitudes of small bodies circling through space, each in its own orbit, and that at some time or another these objects approach the Earth. These small bodies are travelling more than one hundred times as fast as a rifle bullet, and when they enter our atmosphere their speed



THE EARTH AS A PLANET AMONG OTHER PLANETS

The Solar System comprises the Sun, planets, satellites, comets [illegible] Saturn [illegible] our Earth is one of the planets with the Moon as its satellite. [illegible] Venus, Mars, Jupiter, Saturn, Uranus [illegible] Neptune and their positions [illegible] the Earth [illegible] shown in this picture. Another planet named Pluto [illegible] but [illegible] present. [illegible] in which the Earth [illegible] many other [illegible] and all these form the Universe.

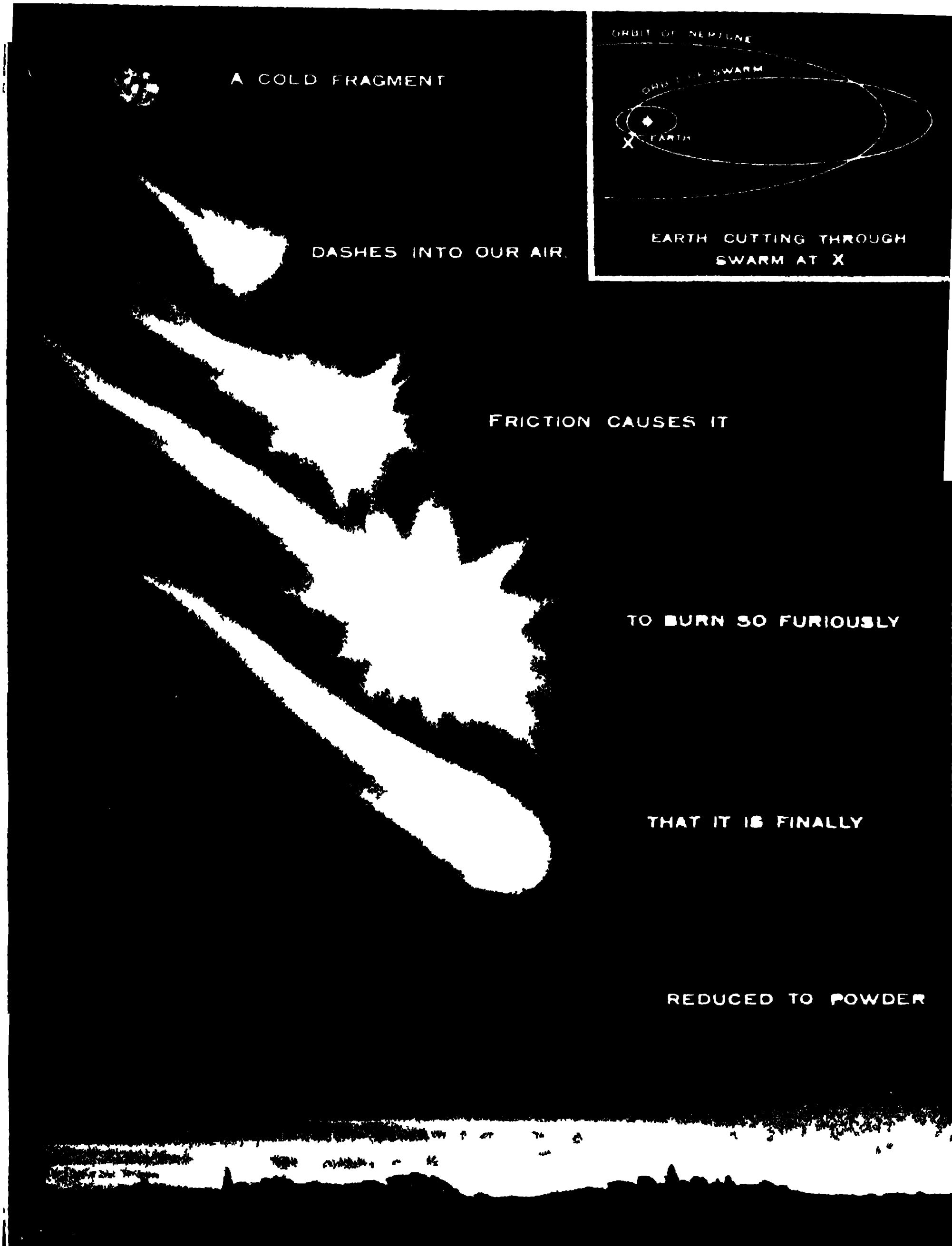
N P K VIII p 162.



FLAMING OUTBURSTS FROM THE SUN

Of all the heavenly bodies the most important to mankind is the sun, and from earliest times men have recognised its beneficent power. Its grandeur and wonder have been realised more fully since the invention of the telescope enabled astronomers to study it more carefully from the earth, 92,830,000 miles away. Among the most notable features of the solar phenomena are the great scarlet prominences shown in the picture above. These are immense outbursts of flaming hydrogen rising, sometimes to a height of 300,000 miles.

THE STORY OF A METEOR



Every hour of the day and night the Earth is colliding with meteors. Although these as a rule are very small, the death rate would be fearful if we were not protected by our atmosphere against these celestial bullets. The terrific speed at which meteors strike into our atmosphere reduces all but the largest to powder before they reach the ground. The small diagram at the top gives the path of the swarm of Perseid meteors that the Earth meets at regular intervals.

is so great that they are heated to incandescence by the friction of their movement through the air. They vary in brilliance from being large enough to light up the landscape for miles around, to being but a faint streak. The brightest are known as fireballs; the next as meteors; and the faintest ones as shooting stars. It has been calculated that over 400,000,000 of these bodies are captured by the Earth every year. There are on an average about a hundred fireballs every year, and meteors and shooting stars may be seen almost any clear night.

A Huge Meteorite

Occasionally a meteor is of sufficiently large size to withstand the terrific heat generated by its passage through the atmosphere, with the result that it does not melt entirely, but some part of it reaches the Earth, falling as a hard mass that is known as a meteorite Despite many ancient traditions relating to the fall of meteorites from the sky, it was not generally believed that it was possible for these bodies to reach the Earth until 1803, when there was undoubted evidence that a meteorite did fall at Laigle, in France. One of the most famous objects of this class fell in 1876 at Rowton, in Shropshire, and may now be seen in the South Kensington Museum, where there is a splendid collection of meteorites. Some meteorites are so large that they weigh several tons, the largest so far known being one of three brought from Greenland by the famous Arctic explorer, Peary. It weighs 36½ tons and measures 11 ft. × 7 ft. × 5 ft.

The majority of meteors and shooting stars are dissipated as they travel through the atmosphere, and their remains fall lightly to Earth in the form of a fine metallic dust. When this dust is examined with a microscope it is seen to consist of tiny rounded particles, from which the rough corners have been worn by friction with the atmosphere. Meteoric dust is infinitely finer than sand grains and differs from them considerably in that, whilst sand grains are rough and unshapen, meteoric dust is rounded like shot.

The appearance of a meteor cannot be predicted, because it is quite invisible until it enters our atmosphere. We can say, however, that on certain nights there will be more

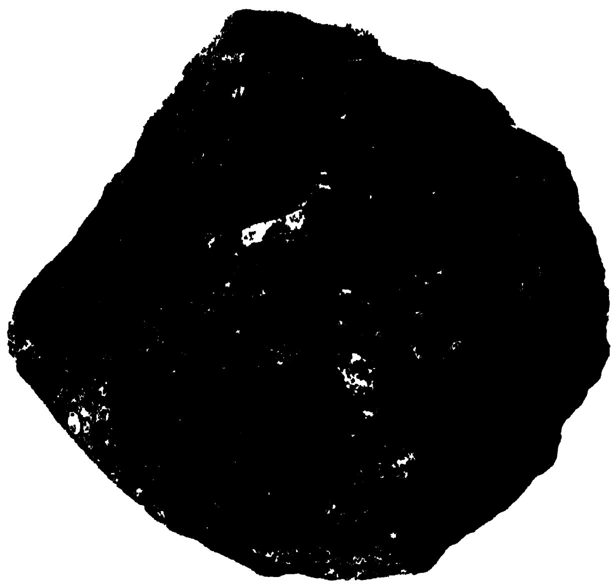
IRON FROM THE SKY *Ellison Hawks*

Meteors nearly always contain a large amount of iron This is a picture of a meteor that fell near Wellington, in Shropshire, on April 20th, 1876, and which is almost pure iron. The outer part has been fused by heat caused by a swift passage through the Earth's atmosphere.

meteors than at ordinary times. This is because meteors travel around the Sun in streams, and we know that on certain nights the Earth will cross one or other of these meteor streams.

The Leonids

On the night of the 13th November, 1833, there occurred what was probably the finest display of meteors ever seen by man—it is estimated, indeed, that on that occasion something like 240,000 meteors were seen. After this wonderful display had taken place it was remembered that Humboldt had observed a similar shower in 1799, or thirty-three years before.



ANOTHER BRITISH METEOR — Ellison Hawks.

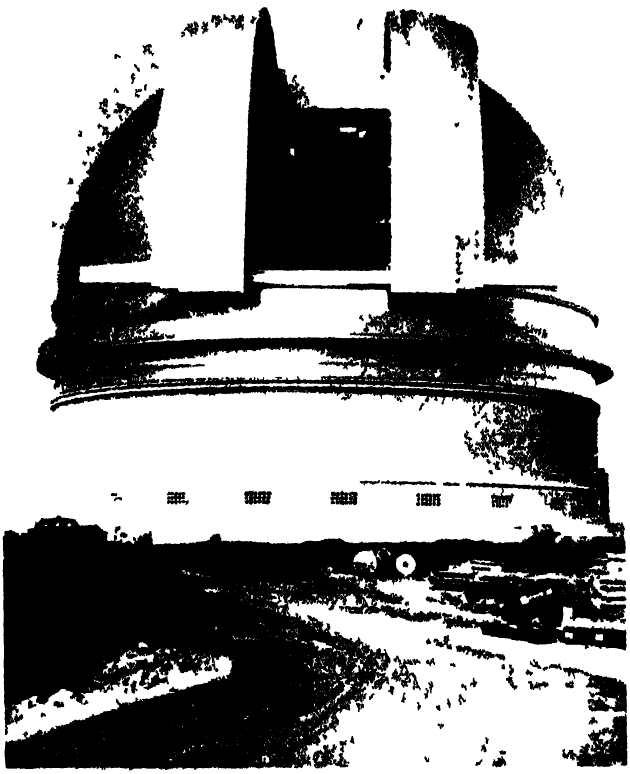
This lump of mixed stone and iron fell near Scarborough in Yorkshire, on December 13th, 1795. It is one of the largest meteors that ever fell in England, and weighs 56 pounds. This photograph is one third the natural size.

Further inquiries resulted in the discovery that there had been showers of shooting stars every thirty-three years for at least a thousand years preceding. It was suggested, therefore, that these displays were caused by the same stream of meteors, and because the paths of the meteors of 1833 all seemed to commence at the constellation called Leo, these meteors were called the "Leonids." It was confidently predicted that as the Earth crossed this meteor stream about every thirty-three years, another display could be expected in 1866.

As the shower again duly appeared and was an impressive spectacle, astronomers had no hesitation in predicting a further display in 1899. Although hundreds of people in every town and city sat up to watch through the night, they were disappointed, for, remarkable to relate, the meteors did not put in an appearance! It was apparent that something had happened to prevent their return, and it was suggested that the orbit of the meteors had probably been diverted by the attraction of the giant planet Jupiter.

COMETS, VISITORS FROM SPACE

FROM what we have read, we realise that there are certain definite facts known about the planets. In the first place, they may be regarded as being more or less solid objects; they move around the Sun in orbits that are almost circular, never travelling so far away as to be lost to our sight; and they are regular in their motions—that is to say, we can predict their positions with accuracy. We have now to consider an entirely different class of heavenly bodies—comets, which differ from planets in almost every respect.



Planet News

HOME OF THE WORLD'S BIGGEST TELESCOPE

The idea and plans for the greatest telescope ever made were put forward by the famous American astronomer, the late Dr George Hale and towards its cost £1 500,000 was granted by the Rockefeller Foundation. This photograph shows the exterior of the Hale Observatory at Mount Palomar

Comets and their Tails

The name " comet " comes from the Latin *coma*, " a hair," and these objects are so called because they often carry a hair-like tail Strange to say, we do not know what comets really are, nor what is their origin. For one thing, there have not been many bright comets that could be examined with modern instruments, the majority of those visible in recent times being comparatively small. It seems probable, however, that comets are largely composed of gaseous matter, or at the most consist of swarms of meteors, held together by their mutual attractive powers.

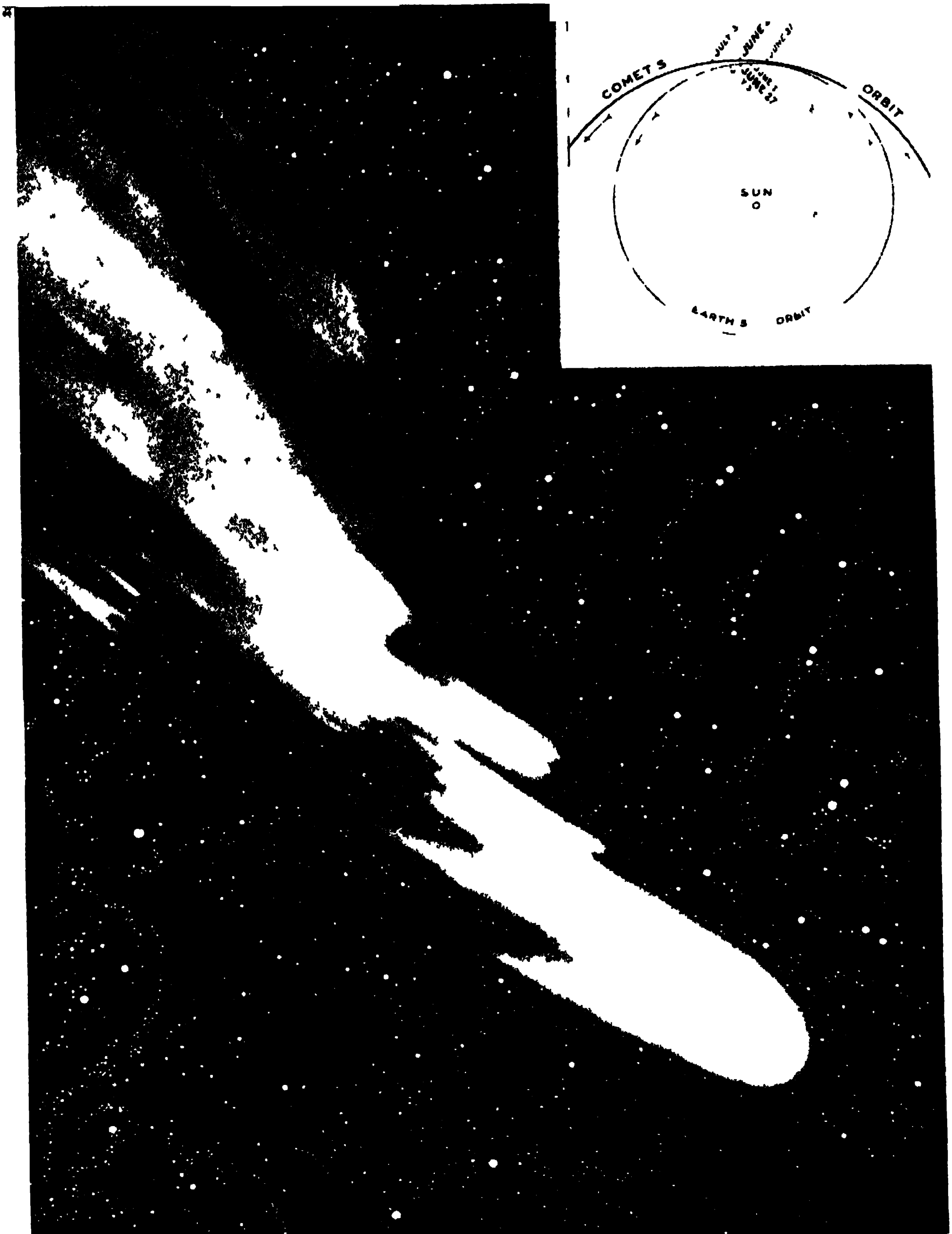
A comet consists principally of two parts—the head, or nucleus, and the tail. Although the heads of different comets do not differ very much from each other except in their size and colour, there are considerable differences in their tails Sometimes these are short, whilst at other times they are curved and long Often there is more than one tail, and comets without tails are not unknown Almost without exception, however, the tails of comets point away from the Sun as though there is some kind of solar force that repels them.

The Ellipse and the Parabola

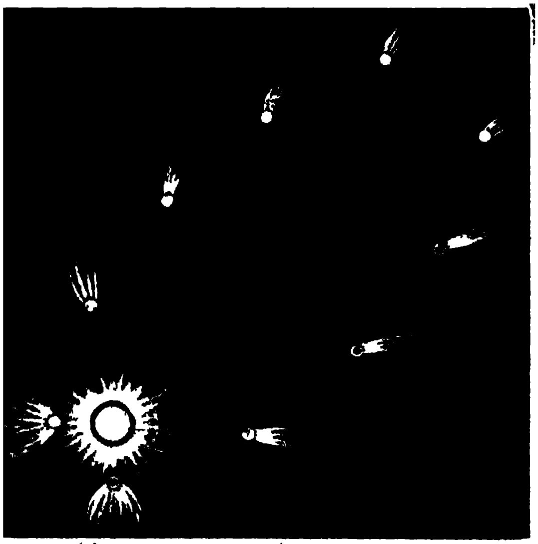
Another point of difference between comets and planets is their movement through space In most cases this movement is so irregular that it is impossible for us to tell when a bright comet will be seen in the heavens To understand this we must explain that there are two kinds of comets—the solar comets and the interstellar comets The former follow regular paths and belong to the Solar System, but the latter travel far out in the depths of space among the stars—as their name implies.

Those of you who have studied geometry know the difference between an ellipse and a parabola. The solar comets travel in elliptical (or closed) orbits in one of the foci of which the Sun is situated The interstellar comets travel in parabolic (or open) orbits that are quite different from the type of orbit pursued by the solar comets. A comet

COMETS ARE MERELY GAS



Comets are very tenuous and must be much more rarefied than fog. Stars can be seen through their tails, which sometimes are millions of miles in length. This is a picture of the famous Pons Winnecke comet, seen about every six years. It is of a strange and unusual shape, and is believed to have a solid head. The small diagram above shows a portion of its orbit.



THE PATH OF A COMET

A comet does not circle the Sun as do the planets, but travels in a different kind of orbit. Its journey may carry it far into the depths of space and take many years to complete Halley's comet requires 75 years to complete one revolution of its orbit.

that travels in an elliptical orbit returns at regular periods, but as a parabola is an open curve with its two branches stretching away from each other and always getting further apart, a comet that travels in this type of orbit visits the Solar System only once. Unfortunately, the largest and brightest comets of history seem to have belonged to the interstellar comets which have come unexpectedly and are not subject to periodical returns.

Comets as Portents

It would seem that in past ages comets excited even more fear than total eclipses. Perhaps this was due to the fact that, although the ancients were able to predict eclipses, they were quite unable to give any idea as to when a comet would appear. It was thought that comets were signs sent by the gods as a warning of some coming disaster. Others associated comets with any extraordinary happening that might chance to occur at a convenient time. For instance, the Romans thought that a great comet that appeared in 43 B.C. was a chariot sent by the gods to transport the soul of Julius Cæsar, who had been assassinated shortly before.

William of Malmesbury, writing about the death in 1060 of Henry, King of France, said: "Soon after, a comet—denoting as they say, a change of kingdoms—appeared trailing its extended and fiery train along the sky. Wherefore a certain monk of our monastery, bowing down with terror at the sight of the brilliant star, exclaimed: 'Thou art come. . . . I have seen thee long since, but now I behold thee much more terrible, threatening to hurl destruction on this country.'" Later, the immortal Shakespeare voiced the general opinion when he wrote those celebrated lines in "Julius Cæsar":

"When beggars die, there are no comets seen;
The heavens themselves blaze forth the death of princes."

It is rather fortunate for Astronomy that the ancients were so interested in comets, for their records—and particularly those of the Chinese—have been of the greatest assistance to us in tracing out the past appearances and history of certain comets.

Halley's Comet

A whole book could be written about the famous comets of history. As our space is limited, we can only briefly mention one that is of great interest. This is the comet named after the celebrated English astronomer, Halley, a great friend of Sir Isaac Newton, who in his famous "Principia" made the suggestion that comets revolve around the Sun as the planets do.

Halley determined to investigate the orbits of certain bright comets, and he mapped out the orbits of 24, which had appeared between 1337 and 1698. He noticed that there were three that followed orbits so remarkably similar that, it seemed, they could scarcely be three different comets but rather three different appearances of the same comet at intervals of seventy-five years. Going further back, Halley found that a bright comet had been seen on three previous dates separated by similar intervals to those that separated the three later appearances. This made six appearances in all, each separated by a period of seventy-five years.

Halley predicted that the comet would return again in the year 1757. He did not live to see the fulfilment of his prediction, for he died in 1742, eight years after his prediction had been made. His work was not forgotten, however, and as the year 1757 drew near, preparations were made by several astronomers to search for the comet. But all the professional observers were outdone, for the comet was discovered on Christmas night, 1758, by an amateur astronomer, named Palitzsch, with only a small telescope.

The fulfilment of the prediction definitely established the fact that some comets do return at regular intervals, and we shall always remember that we owe this discovery to Edmund Halley.

The Tail of the Comet

Although it is a long time since people regarded comets as warnings of fateful things to come, the more superstitious peoples of the world still show alarm when one of these fiery phenomena appears in the sky.

On the last appearance of Halley's Comet, early in the present century, it was known that the Earth would pass through the tail of the comet. Some primitive Asiatics, fearing the worst, are said on that occasion to have prepared barrels of water into which they could leap for safety when the dread time came. Actually, in passing through the tail of the comet the Earth went through a vacuum more complete than any man can produce, and there was no need for such panic-stricken preparations.

When Halley's Comet appeared on this occasion, it was calculated that it reflected as much of the light of the Sun as would a single body with a diameter of 25 miles, and that its transparent surface—as far as could be seen—was about 300,000 times the size of such a body.

A COMET WITH MANY TAILS

This was the third comet of the year 1908 and is therefore known as 1908c. The comet was remarkable for the many different changes that occurred in its appearance.

Modern astronomers have noticed that comets seem to deteriorate. Each time they circle the Sun, there is a wasting away. In 1846 astronomers actually saw the destruction of Biela's Comet. The two parts into which it broke were seen, six years later, to be a million and a half miles apart, and that occasion was the last appearance of the comet.

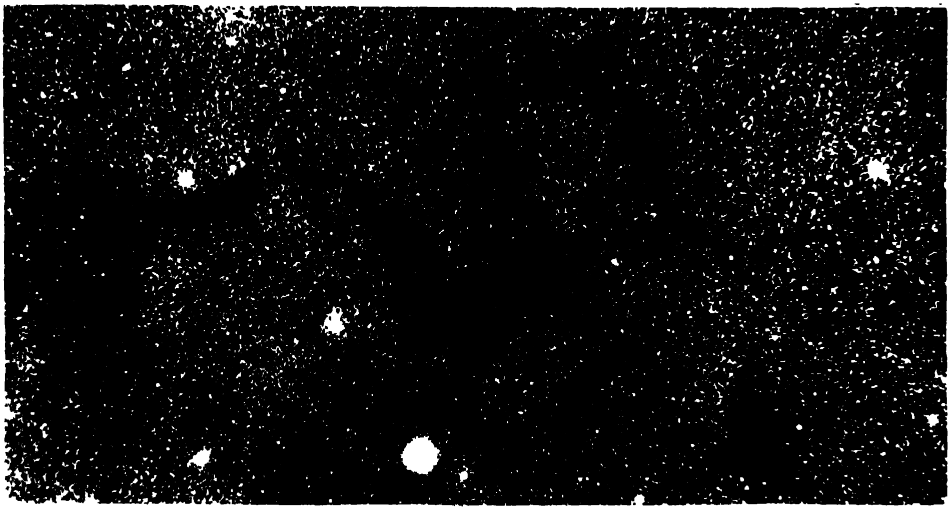
In 1872, when Biela's comet should again have been seen, all that was observed was a particularly fine display of meteors.

Of recent years, 1939 was one of exceptional comet activity. The return of five periodic comets was observed, and five new comets were discovered, one of which was bright enough to have been seen with the naked eye.

THE GIANT EYE OF MOUNT PALOMAR

Here we have a view of the massive tubular supports forming the electrically controlled frame to hold the 200-in. telescope at the Hale Observatory, Mount Palomar, California. At the base of the structure is the mounting for the great concave mirror. By way of contrast an observatory worker can be seen in the space below the giant framework, standing beside a standard 4-inch telescope.

THE STARS IN THE SKIES



Ellison Hawks.

PART OF THE MILKY WAY IN THE CONSTELLATION OF OPHIUCHUS

The photograph clearly shows some of the remarkable "dark lanes," believed to be due to heavy gaseous clouds that blot out the stars behind.

THE objects that we have considered — planets, comets, and meteors—all belong to the Solar System, revolve around the Sun, and are governed by his gravitational powers. We are now to learn something of the stars themselves, which are vastly different from the planets.

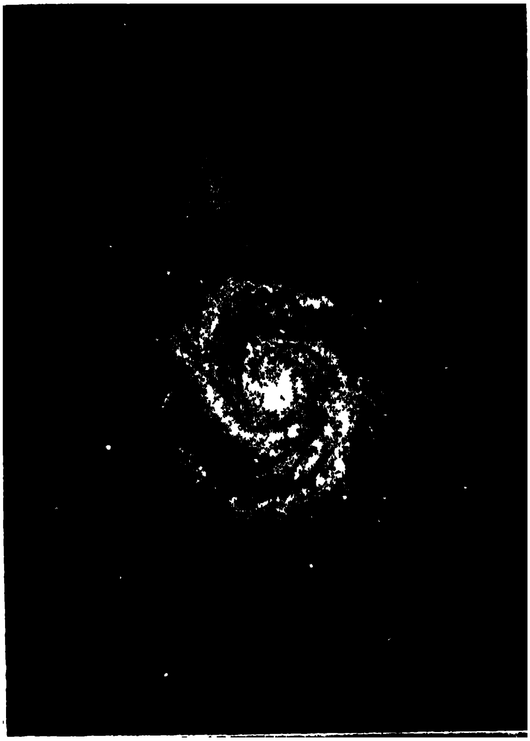
In the first place, there is the difference in their appearance to which we referred when dealing with the discovery of Uranus. Even with the naked eye one can tell the difference between a planet and a star, for whereas a planet seldom twinkles, but shines with a steady light, a star twinkles almost unceasingly.

Then again if we look through the telescope a planet presents a definite disc, whereas a star is but a shining point of light no matter how powerful the telescope may be. But the greatest difference that we can observe is the fact that the stars never change their positions relative to one another, whilst night by night a planet moves its position among the stars. The name planet means "a wanderer," and it was given to these objects by the ancients. They had noticed that these objects moved about the sky.

As we have already seen, the planets are other worlds circling round the Sun in company with the Earth. We have now to learn that the Sun is a star, and the stars themselves are suns. Whether or not these other suns have planets circling around them—as our star has—we do not know, because they are so far away that even our most powerful telescopes could not show them.

Distances of the Stars

The distances of the stars are indeed enormous—Alpha Centauri, the nearest star, is over 25 billions of miles away from us. This is a number that we cannot be expected to understand, but let us try to gain some idea of what it means. If we were to commence counting, we should have to spend something like 300,000 years without



AN ISLAND UNIVERSE

This spiral nebula is to be seen in the constellation of *Canes Venatici*, the "Hunting Dogs." The nebula, which lies in the remotest depths of space, may be a universe in process of being formed. When you look at it your eyes are receiving light that left it thousands of years ago

stopping day or night before we reached 24 billions!

Many of you no doubt have heard of the red corpuscles—tiny discs in our blood. They are so minute that if it were possible to pile one on top of another, as coins are sometimes seen piled in a bank, it would take about 15,000 corpuscles to form a pile one inch in height. If we allow one corpuscle to stand for each mile in the distance that separates us from Alpha Centauri, we should require a pile no less than 26,000 miles in height to represent the total distance! Sirius, the brightest star in the sky, is over twice the distance of Alpha Centauri.

These illustrations refer only to the distance of the nearest star, and would not serve to represent the distance of the majority of stars, in comparison with which Alpha Centauri and Sirius are comparatively close to us.

Meaning of "Light-year"

Astronomers have found that it is useless to endeavour to express a star's distance in miles, and so they use another standard. We know that light takes time to travel through space, exactly as sound takes time to travel through air. If we watch a gun fired say a mile away, we first see a puff of smoke and then hear the report of the explosion, the interval between depending on our distance from the gun. Sound travels about 1,100 ft. a second, but light is infinitely more swift, travelling some 186,000 *miles* a second. At this rate it takes but a second and a quarter to reach us from the Moon, and about eight minutes from the Sun. To cross the intervening gulf of space from Alpha Centauri, however, it requires four years and four months, during which time it is travelling at 186,000 miles each second! Thus, if Alpha Centauri were to be extinguished at the present moment it would continue to be visible to us as a star for four years and four months.

Astronomers use the rate that light takes to travel to express the distance of the stars. Alpha Centauri is said to be 4⅓ light years: Sirius is 8½ light years; and Procyon 10½ light years distant. Vega, the bright blue star in the constellation of Lyra, is some 21 light years distant; and Polaris, the Pole Star, is 44 light years away from us. If you are interested in making calculations you can easily work out the distance in miles of any of these stars, by multiplying the number of seconds

in the light years, and again multiplying your result by 186,000.

We must mention that it is not necessarily the brightest stars that are nearest to us. Everyone knows that the stars are not all of the same brightness—indeed, it has been said that no two stars shine with exactly the same amount of light. Although the bright stars may seem to be nearer to us than the faint ones, it is more than likely that they are larger or more luminous suns at a great distance, while the faint stars may be smaller or less brilliant suns near at hand.

The stars are divided into constellations or groups, and it is believed that this was done ages ago by the Chaldean shepherds. They fancied the stars formed figures in the sky, just as we sometimes imagine we can see pictures in the fire. The Chaldeans gave these star figures names, and these same names have persisted to this day. The Chaldean shepherds also made up imaginary tales and legends about the deeds performed by their heroes in the skies, and although most of these stories have been lost a few of them have been handed down to us to-day.

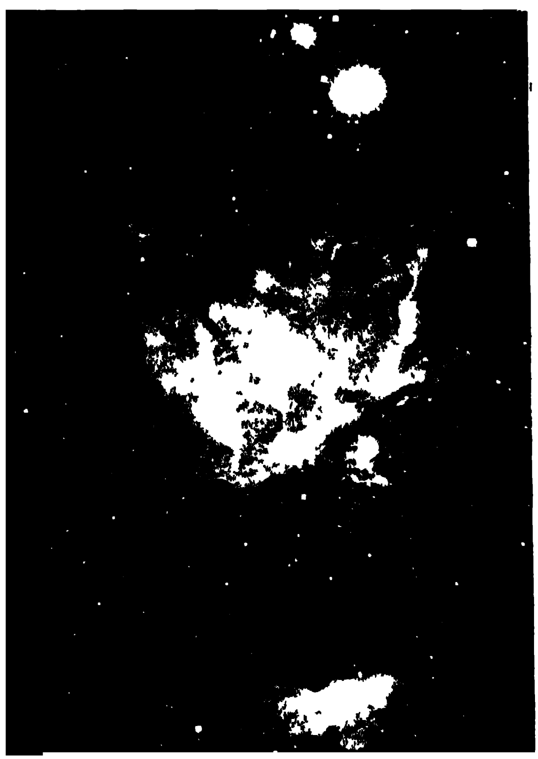
Since the days of the Chaldeans much knowledge has been gained of the heavenly bodies by means of the telescope and the spectroscope. Yet the wonder remains that without these comparatively modern aids to the astronomer these wise men of ancient Babylon were able to learn so much and to pass on their knowledge to others.

Some of the brighter stars themselves are now known by special names, but the majority are known by prefixing a Greek letter to the name of the constellation in which they are situated.

STAR MAGNITUDES

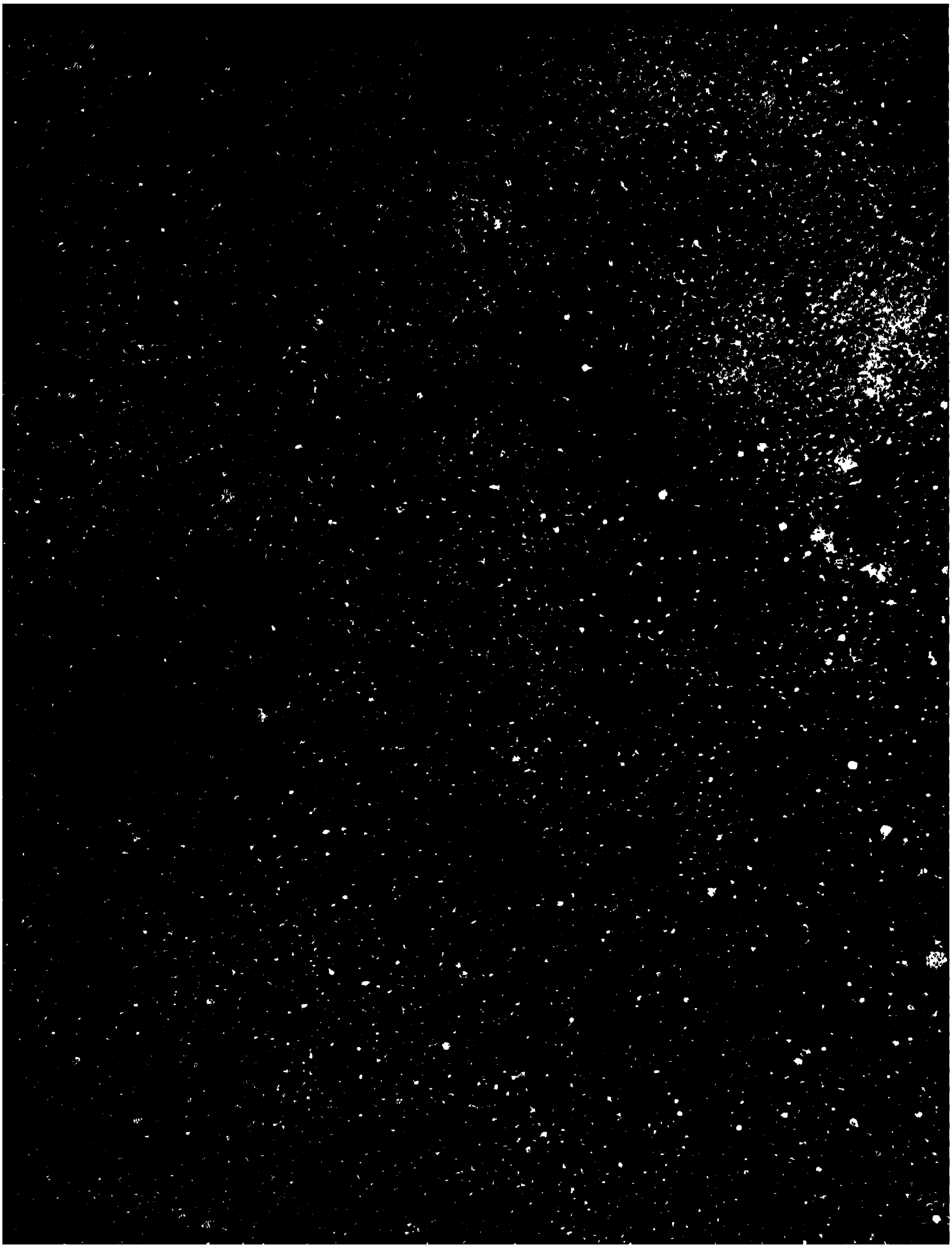
WE have said that stars are not all of the same brightness. They are classed by magnitudes, which, however, do not take into account the actual size of the stars, but only deal with their brilliance as it appears to us. We must remember that although the bright stars seem to be nearer than the fainter stars, it by no means follows that this is actually the case. The astronomer takes all these facts into account when engaged on the long task of classifying the stars according to their different magnitudes.

It has been found that the number of the stars in each magnitude increases in a certain proportion down the scale. Roughly speaking, each magnitude has



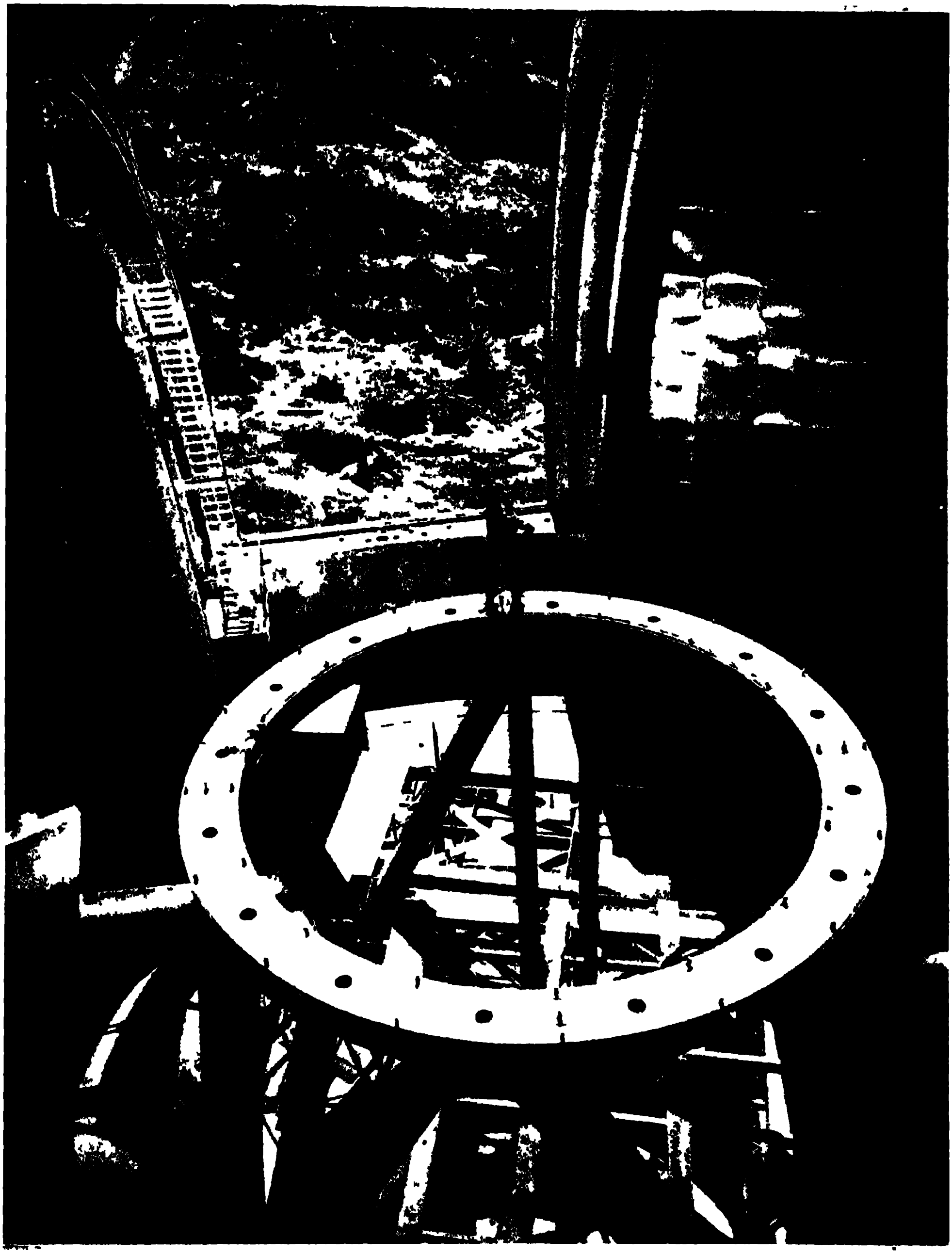
THE GREAT NEBULA IN ORION

One of the grandest objects in the heavens The astronomers' telescopes reveal hundreds of thousands of these wonderful nebulæ of all sizes and shapes



Part of the Milky Way in the constellation of Cygnus, the Swan. This is one of a series of remarkable photographs revealing the Milky Way to be composed literally of clouds of stars, each one of which is a sun.

A ROOM WITH A VIEW



This photograph gives another aspect of the Observatory at Mount Palomar. One of the workers stands on the mounting for the great 200-inch telescope during its last stages of completion in 1948. The revolving dome, through the aperture of which the man is looking, runs on rails built on the massive concrete walls well over 60 feet high. It is calculated that it will take many years to chart all the stars which the giant telescope has brought into vision.

about three times as many more stars as the preceding one. Thus, there are 11 stars of the first magnitude, 39 of the second, 133 of the third, 446 of the fourth, and so on. Stars of the first magnitude give about 100 times as much light as those of the sixth, and about a million times as much as those of the sixteenth.

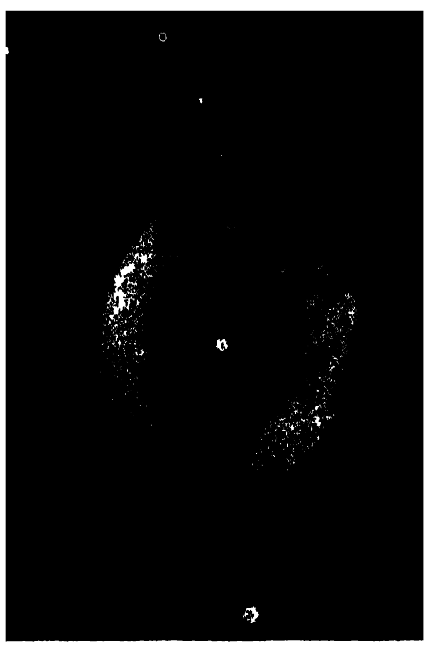
There are a few stars that are brighter than the average stars of the first magnitude, and these are specially classified. If we take Aldebaran (in the constellation of *Taurus*, the Bull) as a typical first magnitude star, Sirius (in *Canis major*, the Large Dog) is about nine times as bright and is said to be one and a half times above first magnitude. Sirius is the brightest star in the Northern hemisphere.

The Number of the Stars

People with fairly good sight can see stars of down to about the fourth magnitude, whilst those with keen sight can see stars down to the sixth magnitude. If we look up at the sky on a clear night we may think we can see tens of thousands of stars. As a matter of fact a person of average sight can see only about 500 stars with the naked eye. Those with keen sight can see about 4,500 stars without a telescope, whilst quite a small telescope will show stars down to the ninth magnitude, of which there are about 140,000 visible. The 40-in. telescope of the Yerkes Observatory will probably show 100,000,000 stars, whilst the 100-in. reflector of Mount Wilson can photograph stars of about the twenty-first magnitude, of which it is estimated there are at least a billion!

Star catalogues have been made from time to time, and include the position of the stars measured as accurately as possible in the circumstances appertaining at the time the catalogue was made. The first star catalogue, made by Hipparchus, the Greek astronomer, contained the places of 1,080 stars, but unfortunately it is lost. The oldest star catalogue we possess, made about 137 A.D., is contained in Ptolemy's *Almagest*, and gives the position of 1,025 stars. In 1580, Tycho Brahe compiled a catalogue of 1,005 stars, which catalogue was the last to be completed before the invention of the telescope. In 1862, Argelander, at Bonn, in Germany, completed a more modern catalogue Using a 2½-inch telescope, he catalogued over 324,000 stars.

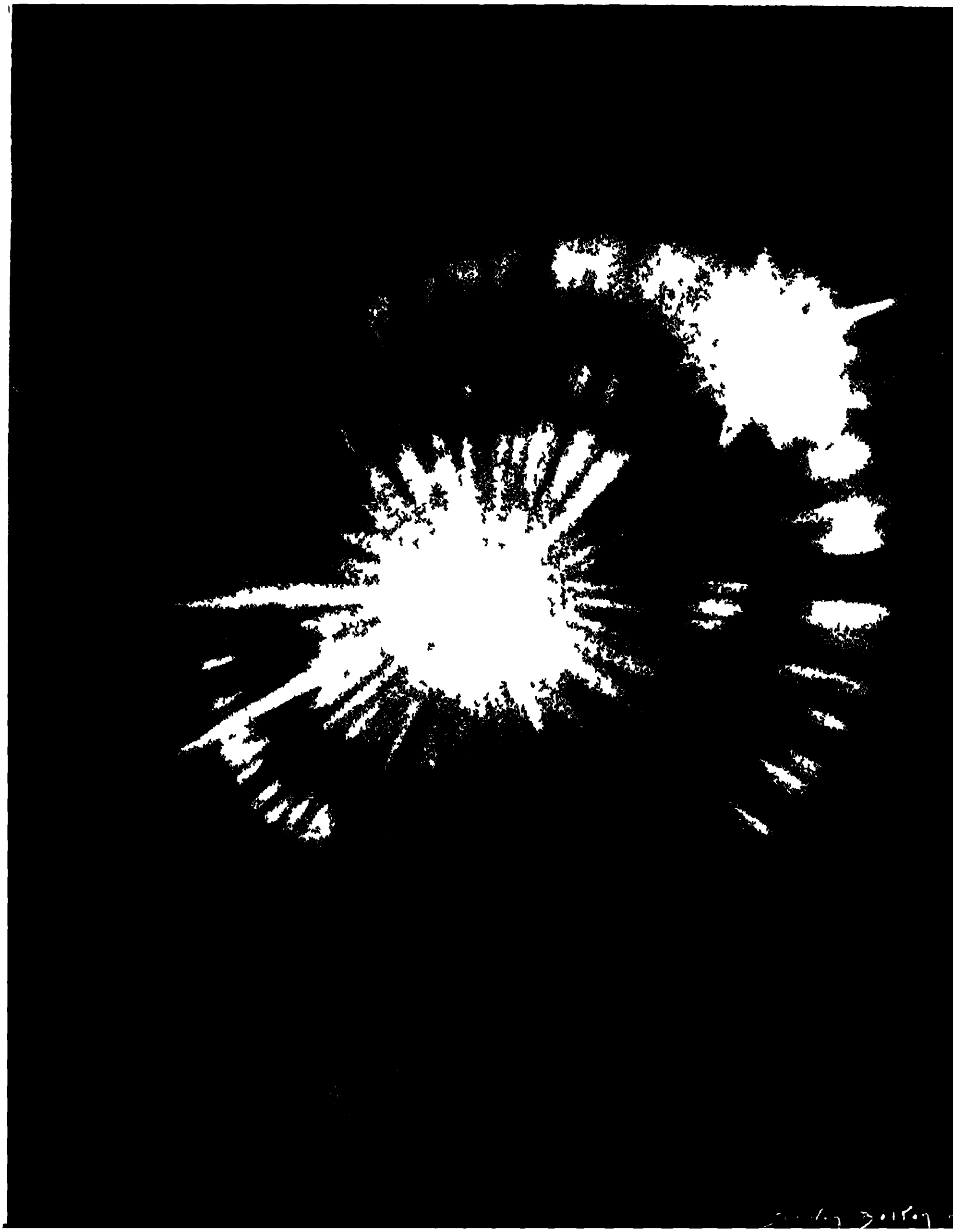
The introduction of the photographic dry plate was of great importance to Astronomy, for photography enables accurate records to be made of star positions. In 1887 a great photographic catalogue was planned, the work being shared by eighteen observatories—Algiers, Bordeaux, Cape of Good Hope, Catania, Cordoba, Greenwich, Helsinki, Melbourne, Monte



A RING NEBULA

This curious object is the annular or ring nebula in the constellation of *Lyra*, the Harp.

A STAR THAT SPLIT



Great interest was caused among astronomers when in 1925 a new star called *Nova Pictoris* was seen to flare up and (apparently) to split into two This was the first recorded instance of a star becoming double before our eyes as it were although there are many double stars to be seen in the heavens Although this tremendous upheaval occurred some 500 years ago, it is only now that we are able to see it It has taken all those centuries for light to bridge the tremendous gulf that separates our little planet from this giant cataclysm

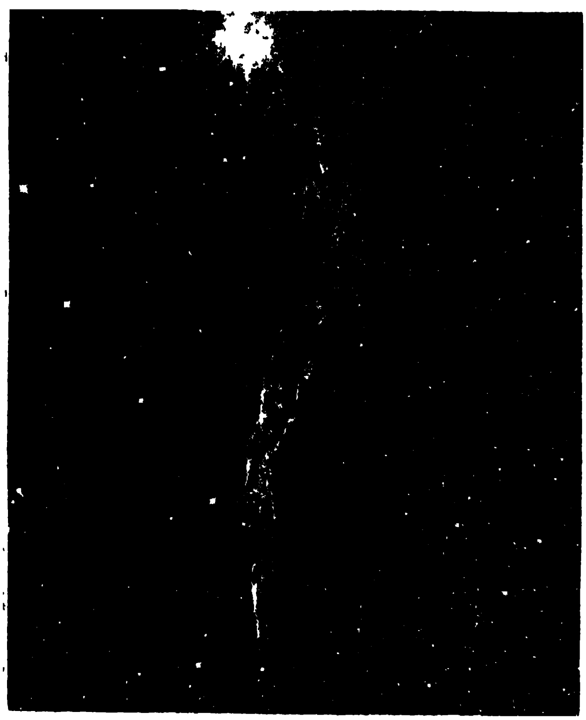
Video, Oxford, Paris, Perth (Western Australia), Potsdam, Rome, San Fernando, Sydney, Tacubaya, and Toulouse—each observatory undertaking to photograph a certain part of the heavens. The whole catalogue will necessitate the exposure of 100,000 plates. The work has already taken many years, but steady progress has been maintained. It is estimated that when the catalogue is finished the position of nearly 4,000,000 stars will be recorded. Not only will this catalogue be of the greatest value to generations of astronomers who follow, but it will be a marvellous achievement—a triumph of accuracy, perseverance, and patience.

The Stars are Moving

Early star catalogues have been of great assistance to astronomers in helping them to find out what changes are taking place in the position of the stars—for the stars are not fixed in space, as they are generally supposed to be. Their movement in space (called the "proper motion") is quite distinct and separate from their movement across the sky each night, which, of course, is simply due to the Earth's rotation on its axis. Over 200 years ago Halley discovered that the two bright stars Sirius and Arcturus had changed their places since the days of Ptolemy. Sirius had moved southwards by about half a degree and Arcturus by a full degree.

Some of the stars have enormous proper motions—that is to say, they are moving at incredible speeds—but, owing to their enormous distances from us, their movements in the sky can only be detected over a comparatively long period of time. One of the swiftest moving stars is that known as Groombridge 1830. This star is of the sixth magnitude and is moving at a speed of about 528 miles a second. Another star with a high proper motion is an eighth magnitude star in the constellation of Pictor. As the star is at about the same distance from us as Sirius, it is therefore either much smaller or less brilliant than Sirius, for it is not visible to the naked eye. Its proper motion is such that in about 200 years its position will have altered by nearly as much as the diameter of the full Moon.

It is interesting to know that our star, the Sun, also has a proper motion. Accompanied by the planets and their satellites he moves at a speed of about 13 miles a second.

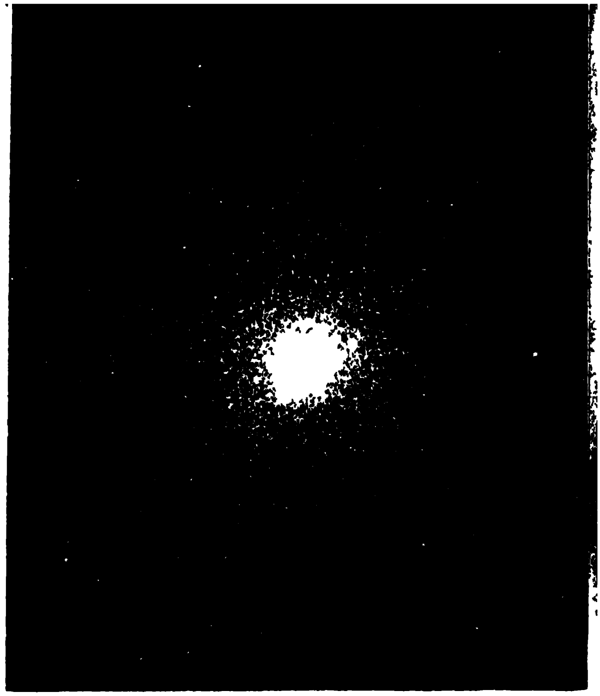


THE "BRIDAL VEIL" NEBULA

The beautiful "Bridal Veil" nebula in the constellation of Cygnus, the Swan

The Nebulæ

Scattered about the heavens are a class of objects that in the telescope look like misty patches of light. These are the *nebulæ*, or "little clouds," some of which were seen by the ancient astronomers. Some were studied by Galileo, who came to the conclusion that they were clusters of stars so far away that the individual stars of the cluster could not be distinguished (or "resolved," as it is called) by the telescopes of that time.



A STAR CLUSTER

This stupendous cluster of stars is in the constellation of Hercules. Our photograph, which was taken with the 60-inch telescope at Mount Wilson, was exposed for no less than eleven hours.

The great astronomer Herschel was the first to suppose that the nebulæ were not all of a starry nature, and that some were gigantic clouds of glowing gas. This suggestion led to much discussion and argument, and in the attempt to settle the matter much attention was paid to these objects, observer after observer endeavouring to show that they were star clusters as Galileo had said. Nor were the efforts confined to observers, for every telescope maker tried to produce instruments of sufficient power and optical qualities that would resolve all the nebulæ into star clusters. It was left to Sir William Huggins to prove (in 1864), with a wonderful instrument called the spectroscope, that all the nebulæ could not be clusters of stars, and that some at any rate were composed of glowing gas as Herschel had said.

The nebulæ have been called "the workshops of the Creator," for here, it is believed, new stars and new star systems are being formed.

As we have mentioned, a few of the brightest nebulæ are visible to the naked eye. Many more can be seen with a small telescope, but by far the greater number can be studied only by photography. The first photographs of nebulæ were taken by Henry Draper, of New York, in 1880. Since that time thousands of photographs have been taken and an immense number of these objects have been revealed. It has been estimated that with only an hour's exposure about 300,000 nebulæ could be photographed with the 60-inch reflector of Mount Wilson. There would be a much greater number within the range of the 100-inch telescope, and the number revealed by giving longer exposures is enormous. Although many of the nebulæ are of a spiral form, there are many others of diverse shapes. They are all most beautiful objects.

It is now well established that there are also many dark nebulæ, which

do not shine. These non-luminous clouds of gas are only detected because they obscure the stars that lie behind them. Some of the best known of these dark nebulæ are found in the constellation of the Southern Cross. Because the absence of the stars that they obscure can be noticed by the naked eye, sailors have named the black parts the "coal-sack."

The Milky Way

On a clear night we can see a faint band of misty light stretching overhead. It is of irregular width and outline and is called the Milky Way. Aristotle supposed it to be due to the atmospheric vapour, and Anaxagoras thought it was the shadow of the Earth in the sky. When Galileo observed it with his telescope he saw that it was of a different order altogether, and that it was composed of myriads of faint stars so far away from us as to be indistinguishable separately to the naked eye. Much of our present knowledge of the Milky Way is due to the late Professor E. E. Barnard, who first successfully photographed it at the Lick Observatory in 1889. He used a special lens that "covered" a large area of the sky, and that had a great "light grasp" enabling the images of even very faint stars to be recorded. Professor Barnard took hundreds of photographs, exposing his plates for over seven hours. These photographs showed the Milky Way in its true nature. It was found to consist literally of clouds of stars, which in some places are so numerous that it is impossible to distinguish them separately even in the photographs.

Sir William Herschel suggested that the stars in space are grouped in the form of a flattened disc, something like a thin watch. Within the Milky Way are many star clouds, but how many of the individual stars belong to these clouds we do not yet know. One of these star clouds is of particular interest to us, for our own star, the Sun, is almost in the middle of it. This accounts for the fact that the number of the stars increases towards the Milky Way, where, as it were, we are looking through the full length of the disc where the stars are greater in number.

The Smallness of the Earth

Astronomy has taught us many things, not the least important of which is to realise our comparative insignificance. Some people are accustomed to think of their individual importance; others think of the importance of their city, or the importance of their country in the world's affairs. At one time the world's cleverest men thought the Earth was the centre of the Universe.

Astronomy has changed all this, however, and we have come to understand that the Earth is but one of nine planets circling round a comparatively huge Sun; that this Sun is but a Star —one of hundreds of millions of other stars, many larger and brighter than it is—embedded in a huge star cloud, which itself is only one of many such clouds that are included in the Milky Way. We know that our Sun is no more favourably placed than any one of 10,000 other suns in the same star cloud, and that we do not occupy any particularly favourable position in the Universe.

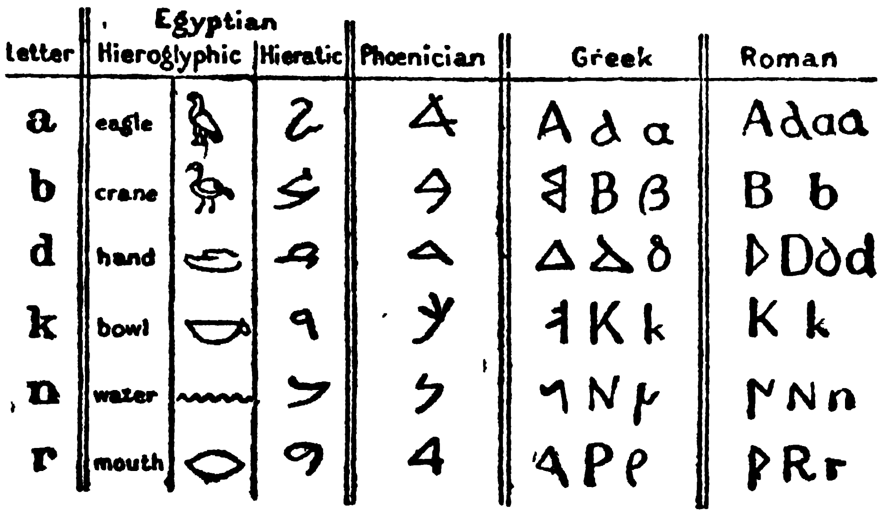
Realising all these material facts, we cannot help our thoughts being led in another direction. We realise there can be only one explanation of all these wonders—"the heavens declare the glory of God; and the firmament sheweth His handiwork."

With the Psalmist we are tempted to ask—

"When I consider Thy heavens, the work of Thy fingers,
"The Moon and the Stars which Thou hast ordained;
"What is man that Thou are mindful of him?
"And the son of man, that Thou visitest him?"

A Guide to the Use of Our English Language

The Priceless Gift of the Written Word



HOW OUR ALPHABET BEGAN

As man progressed from his primitive state he had the desire to write down his thoughts and ideas. His first efforts to express himself in writing were by crude drawings and from these an alphabet gradually grew. This varied in different countries and with the various languages which slowly developed.

THE MAGIC ART OF WRITING

FLAG — MOON — DAISY — SEA: These are just words but you have only to read them once to get a vivid and clear meaning in your mind. Now the words are each composed of a few letters and the letters are merely marks made by printer's ink on paper. Yet they give you in a flash a whole picture: you can almost see the thing they stand for. That, in a nutshell, is the magic of writing or, in this case, of printing, which is, after all, just an artificial or mechanical way of writing.

The Second of the R's

We are going to consider how this magic works and what it can be made to do. The important thing is that any one of you can learn its secrets and use your knowledge to make your life a success. This does not mean that you will all wish to become writers or authors, but in the modern world you can't do any sort of business without some writing.

Even the smallest amount of writing can be done well or badly. The purpose of this book is to help young people to do things well because, to recall the old saying, if a thing is worth doing, it is worth doing well. This chapter will explain what writing is and show you why it is worth doing well. We will consider the magic art in two ways. Firstly, we must think of how to write, then of what to write.

When our Grandfathers and Grandmothers were at school they used to say that they began by learning the three R's; this was a sort of old-fashioned joke, for the three R's were meant to stand for Reading, Writing and Arithmetic, and they certainly all begin with the R sound, but our Grandparents hadn't learned much about writing if they thought it was spelt with an R. And they seem to have lost sight of the A in Arithmetic! But that famous phrase—the Three R's—is a useful reminder that education starts with learning to read, to write and to work with figures. You start by getting to know the shapes of the letters—by reading them; then you learn to make these shapes yourself—that is writing. It is the second of the Three R's which is our concern here, and is probably the greatest of the three.

What is Writing?

Most young boys and girls can draw before they can write. Now the human race, when it was young and just beginning to become civilised, could draw before it could write. Men found that they wanted to say things to other men who were not present at the time, or that they wanted to leave what they thought behind them for others to think about. So they made simple drawings on the walls of their caves. These were rough and rather like your younger brother's drawings of animals and flowers. But they told a simple story carved there with flint on the rock. They were the beginnings of writing.

Men soon saw that if they had much to say they would have to improve these messages to make them express more ideas and at the same time to make them quicker and easier to record. So gradually they agreed that certain marks or signs would represent certain spoken sounds. From this came letters, and once an alphabet was formed, men could combine the letters in endless groups, or words, and could then convey all manner of thought on every kind of subject. They had evolved the written language.

Different Alphabets and Characters

Of course, mankind, scattered over all the world, in different countries, in different climates, and with different voices, naturally did not all work out an alphabet in the same way. But all the alphabets were worked out through the ages for the same purpose: to enable men to put their thoughts down in a lasting form, to write so that others might read. Here are some specimens of the letters and characters used in other lands.

關須給大肝都而佳尤以骨齒，

CHINESE

سی اجك رهی حاصل ادهر محروم آن اهر پرمد هر.

HINDUSTANI

Говорили они мало и мало видили он.

RUSSIAN

Jeder schuf Gott sind zum macht, nichts ist.

GERMAN

Each character is part of an alphabet, or in Chinese may represent a word. And they all have to be *written*.

Other Ways of Making a Record

It is just as well to remember that writing is not the only way in which men and women can make a permanent record of their thoughts. We should remember, too, that although for centuries writing has been the only way, there is no pause in the story of Man's Progress. Nothing can be regarded as established for ever. To-day there is a National Film Library, in which master reels of great films that are considered worthy of being kept for future generations to see are carefully stored and indexed.

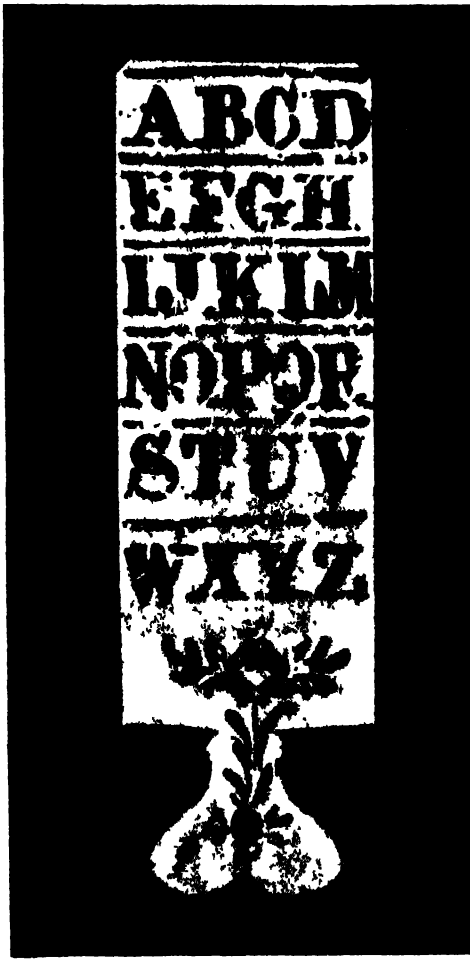
And again, the British Broadcasting Corporation has a vast record library in which the speeches of great persons are

stored and the recorded sound pictures of great events.

The Purpose of Writing

As we have already seen, the purpose of writing is to put thought in permanent and accessible (that is, easy to get at) form. That can be described as the basic principle of writing. But there are many different aspects of this desire of men to put their thoughts on paper, ranging from the rough pencil note which you make to remind yourself of something perhaps only a few hours later, to the very carefully polished words and phrases set down by an author or scholar after years of study, to be read by future generations as great literature. Let us consider a few of these purposes of writing.

Firstly, there are personal or private letters to be written. Most boys and girls, when they have with a great struggle at school learned to write a few simple words, probably begin by proudly sending a little note to Mother, Father, Grannie or Grandpa. They have begun something that will continue throughout their lives. There will always be times when a friend or relation has to be told your news and a letter has to be written. There are still things that can be more easily said, even to a very close friend, in a letter than by telephone or even in conversation.



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AN EARLY HORNBOOK

One of the earliest forms of school primers was the Horn Book This consisted of a piece of paper or vellum, on which the alphabet was printed, covered by a sheet of transparent horn, and mounted on wood

Letters and Diaries

Then there are business letters. Can you imagine the world of to-day, even with its telephones, if there were no business letters? You must learn to write, if only for these two reasons—private and business letters. It would be difficult to go through life without having at some time, and probably frequently, to compose either or both.

But you may want to write for other reasons. Do you keep a diary? Here you will make day-to-day entries of interesting things that happen, perhaps not very important things to-day, but things which in a year or two will recall pleasant occasions or events which may have led to greater and more important milestones in your career.

We cannot mention diaries without thinking of what is undoubtedly the most famous diary written in English. This was just such a diary as you might keep, but it was written faithfully and fully each day and no trivial event or observation was left out. It

was written by Samuel Pepys three centuries ago and it has become a great piece of literature which the historians have studied to learn about England as it was in the days of Pepys. People who love good writing study this diary and enjoy the skill with which Pepys used his language to record his simplest thought. You may, however, get joy from keeping a diary without trying to become another Samuel Pepys and it is one very good way to practise the art of writing.

So far we have thought of writing as an art at the service of everybody. There are, however, people whose business it is to write. They are the journalists and the authors whose profession it is to chronicle or record events, to set down their own and other people's thoughts or to convey important messages from Governments to the people and sometimes from the people to the Governments. Writing for them is a business but it need never cease to be also an art. The most humble journalist on a little village paper who has to report a meeting in the Church Hall, can still, if he is a good writer, produce fine English prose.

Speaking broadly, journalists are those writers who fill the pages of our daily newspapers, our weekly reviews and periodicals, our magazines and quarterlies. They are in turn broadly divided into news journalists and periodical journalists, and you will naturally see that the first group have to write more quickly, have less time to consider how they write, and must arrange their thoughts before the events they are describing have ceased to be " fresh " news.

Journalists and Authors

To become this sort of writer requires special training and long and perhaps tedious practice until you can be quick and accurate and always interesting to read. The periodical journalists, on the other hand, have more time; we say their writing is more " leisurely." They have time to think and consider the effects and results of events; they are less concerned with telling their readers about the events themselves.

These journalists are more akin to the next group of writers—writers of books, or more simply, authors. Authors, in the fullest sense of the word, strive to produce literature rather than what the journalists call copy—that is the journalistic word for the stories and articles they write.

Other Fields for the Writer

It is well said " of the making of books, there is no end." There can be scarcely a home which does not have some books in it somewhere. Books have been written about everything under the sun. So by far the greatest field for the writer is the authorship of books. But you may immediately think of the man who stands out head and shoulders above all the others as the greatest writer in the English language, William Shakespeare. He was a playwright; although now his plays are published in book form he wrote lines for actors to speak on the stage. This is dramatic writing and of the making of plays too it is difficult to see the end. Men who have observed how their fellow men live, how they speak, what sort of characters they have, how now they laugh, how they weep, have put their observations in writing in the form of dialogue. They do not merely tell a story—they make characters, by talking to one another, tell the story.

The most modern type of playwright does not have to consider that his audience is watching his characters. He is the radio dramatist, who writes his plays for performance on the wireless. The speech of his characters, with perhaps just a few sound effects, are all he has with which to hold the scattered audience who may be listening all over the world. The writer's play is usually called a " script."

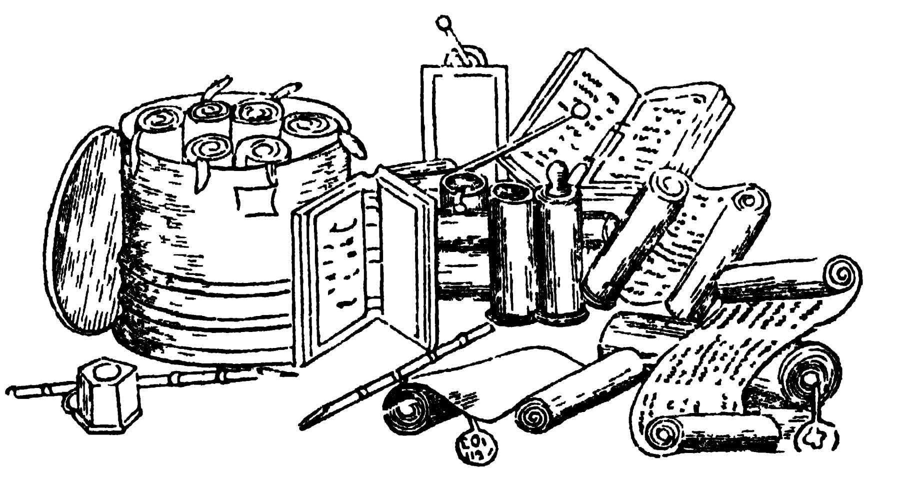
The other modern writers, playwrights too, write the material which is made into films They may soon be writing in a similar way for television They have got back from the period of the wireless play which cannot be seen to the theatre play which the audience watches But they have a scope which the theatre dramatist never had Shakespeare, on the small Elizabethan stage, which did not even have the scenery and all the lighting of the theatre as we know it, had to convey to his audience the places in all corners of the world and in all times of history, where his characters lived You will see that the magic art of his writing was the important thing

The film writer, whose play is called a scenario, is not limited in this way He has merely to say to the producer who makes the film, "I wish my characters to appear next in the Sahara Desert, on a glacier on the Alps, or on board a four masted grain ship on its way from Australia," and the film producer can do it The cinema audience will see the people there But do not think his art is easy The scenario writer has much to learn about the great and complicated machinery of film making To be this sort of writer you will have to study not only writing but the whole fascinating industry of the cinema

What We Write On

It is almost impossible to think of a world without paper This book you are reading, your morning news and the letters you write are all on paper, but just as modern writing is the result of long years of development from the early cave drawings, so paper is the result of progress through the ages in writing material From the wall of the cave on which these first letters in the infancy of man were cut or scraped with flints, the next step probably was to tablets of stone

One person must have thought it would be useful to take his writings or drawings with him, so he put them on a slab of stone that could be carried about or hidden away for others to see at some distant date (You will remember from your Bible stories how Moses, the Great Law Maker of the Israelites,



ANCIENT IMPLEMENTS OF WRITING

In this drawing is shown on the left a case containing six ancient books rolled up and labelled with their titles A stylus and ink stand are in front and to the right a reed pen Waxed tablets joined as with hinges stand near the centre while on the right are more volumes some partly unrolled written on papyrus with title labels attached

wrote the Ten Commandments he got from God on the mountain on tablets of stone.) But these early writers were also beginning to think of other suitable materials, blocks of wood rubbed smooth so that they gave a good writing surface, the inner bark of trees, the skin of animals, dried and made into leather and much later down the centuries when man had learnt to weave cloth from the fibres of plants, linen and paper (as we now know it).

As with the different alphabets, so in different parts of the world were different materials used. It is to ancient Egypt that you must return to see the beginning of the writing material that was to be paper and, indeed, to see the beginning of the very word, paper. The Egyptians from first drawing their hieroglyphics on stone, developed a new art. Along the banks of the Nile in the warm moist atmosphere there grew a reed called the papyrus which was something like a bullrush. In the centre of these reeds was a yellowish white pith which the Egyptians removed. Side by side they laid dozens of these strips, then in the other direction another layer on top of them. They pressed the two together while they were still moist and they were moulded into a thin smooth surfaced sheet which took its name from the reed papyrus. You will see how this idea began both the word and principle of modern paper. It is perhaps not surprising that since our alphabet came from this wonderful civilisation of the Nile the material on which it is used also developed there.

What We Write With

In every phase of this magic art of writing there is a long and romantic story. If you were asked to write your name you would probably write it on paper without even thinking, and you would write it with a pen or a pencil. Now these two tools of the writer are not things that have always been; they also are the result of man's progress through the years. No doubt when tablets of stone or plaques of wood gave way to less hard materials, so the flints were thrown away and replaced by other "markers." Sticks or rough brushes may have been used first, dipped in the blood of animals or in the natural dyes of the trees of the forest. The Egyptians are believed to have used the sharpened end of a reed or feather to write on their papyrus, and we know that in our own British history the first pens were quills. You can make a quill pen for yourself to-day by simply making a slanting cut through the thick "stem" of a feather.

Between Writing and Printing

From the quill developed the metal pen point in a holder. This lasted longer and was smoother to use, but it still had to be dipped in the inkwell. To-day we have fountain pens carrying their own well of ink in their holders.

Your pencil, generally called a "lead" pencil, is not, of course, made of the metal lead; it is really a long thin rod of graphite, with a protective wood skin. The wood has nothing to do with the writing, it is merely for ease in handling and to prevent the brittle graphite from breaking as you work. It does not always do this, as you know to your cost. If you press too heavily your pencil breaks and the wood has to be sharpened away till you have a fine writing point of graphite again. Perhaps you are lucky enough to have a propelling pencil. It is really the first cousin of the fountain pen; it requires no sharpening and carries its own supply of leads.

In the business world, however, letters to-day are mostly written neither with pen nor pencil, but by means of a typewriter. With this wonderful machine one can write at great speed and with great clarity. It is a mechanical writer and comes half-way between simple writing and printing—the process of mechanical writing which is

enabling you to read these lines at this moment. Elsewhere in this work you will find all about printing presses, but remember that even the very biggest of them is doing nothing more or less than reproducing someone's writing.

Hand-writing a Guide to Character

Actual writing, that is, hand-writing, the making of marks with a pen or pencil on paper, is a thing we take for granted. To most educated people to-day it is indeed as natural and effortless as speaking. But you will remember your own early difficulties at school, when you first had to learn to write. Not so many years ago there were many grown-up men and women even in this country who could scarcely write their own names. So we should not take hand-writing too much for granted, even although, like riding a bicycle or swimming, it is an art that once learnt, is never forgotten.

Most children first learn to form the capital letters, then go on to what is called "cursive" writing. This is the usual writing employed for letters, etc. The word "cursive" simply means "run together," one letter linked up to, flowing into, or running on to the next one with no breaks between We will not go over what you learned at school here, except to say that you must always write clearly or legibly (legibly means able to be read). What you may not have learned in your early writing lessons is that your hand-writing is a guide to your character. Like your clothes or your speech, it gives some indication to others of the sort of person you are.

In the field of business and business correspondence you will oner or later discover yet another kind of writing—shorthand. There are several systems of shorthand writing, but they all have the same purpose, to enable words spoken or dictated to be taken down by the shorthand writer in signs which stand for the various sounds of the syllables instead of spelling the words in cursive writing. Because we have shorthand, cursive writing is indeed often referred to as "long hand" to distinguish the two. A shorthand writer is called a "stenographer" and many girls may begin their business careers by learning shorthand in order to become shorthand typists.

Typing, or typewriting, on a machine is the simplest and commonest form of mechanical writing; it is less elaborate, less expensive and more convenient than printing, and again it is much faster than writing with pen and ink. It is of course also much more legible, since the writer's character cannot creep into it—good or bad. When a business man says he writes a letter, he usually means that he has dictated the words he wanted to say to his stenographer or shorthand writer, who from the shorthand notes turns the symbols back into words on her typewriter, producing the finished letter for his signature. His signature is almost certainly the only bit of true writing in the letter.

LETTER WRITING

The Form of the Letter

Just as there are correct things to wear or correct manners at table, so there is an accepted way of setting out the letters you write whether to a member of your family or to an unknown business acquaintance. At the top of the letter comes the heading. This gives the address from which the letter is being sent. It is usually written or printed at the top right-hand corner of the notepaper in this form :—

5, Medway Avenue,
Tunbridge Wells.

If your house is not one with a number in a road or street but has only a name, the address appears like this : —

Cornerways,
Downs Road,
Maidstone,
Kent.

It is not always necessary to put the name of the county, but if your town is small, or, more important, if it is a name like " Newport," of which there are many in England, you must put the county as well, to assist the post office. Some of the counties are shortened by custom like this: Buckinghamshire — Bucks; Hampshire — Hants; Wiltshire—Wilts, and some curiously and unexpectedly like this: Shropshire—Salop.

The next thing to remember is to date your letter. This is placed immediately under the last line of your address in the top right-hand corner. Thus :—

The Thatched Cottage,
Bilberry Road,
Seaton,
Devon.
25th October, 1945.

In the case of a business letter, usually the heading is printed on the notepaper and very often it occupies not only the top right-hand corner, but runs across the whole of the top of the sheet. Only the date has to be inserted You are now ready to start the letter proper, and we will think first of a private letter. Beginning at the left-hand margin and a little lower on the paper than the date you have just put on the right, you commence with the salutation—*Dear Aunt Jane.*

The Salutation

These first few words of the letter—" Dear So and So," are worth a little thought. The word " dear," though it may be a loving greeting in the case of certain friends or relatives is always used. Its use is a courtesy or convention and it is employed even if you do not know the person to whom you are writing. When " dear " is meant to be more than a convention and convey real love or friendship, it is usual to begin " My dear." The name of the person to whom you are writing then follows, and here broadly are the rules for these names and salutations :—

To close personal friends—their Christian name.

To older people from boys and girls—Dear Mr., Mrs., or Miss So-and-So.

If the letter is entirely formal—a business one—you would begin :—

Dear Sir, or *Dear Sirs.*

If you are writing to a woman,

Dear Madam.

(In the case of very official or impersonal letters the customary word " dear " is often dropped, and the salutation becomes simply *Sir; Madam.*)

Salutations to Important People

To ordinary people, as we have noted, you begin your letter *Dear Sir, Dear Madam, Dear Mrs. So-and-So, My dear Jane,* according to your degree of familiarity with the person to whom you are writing. You may well, however, have occasion to write to a person of title or high rank and it is well to know the correct form of salutation for letters to such persons. We have arranged some of these correct salutations in their alphabetical order for your convenience :

Archbishop .	*My Lord Archbishop :* (Note that the wife of an Archbishop has no title and is addressed as plain Mrs.).
Archdeacon .	*Venerable Sir, or Reverend Sir :*
Baron . .	*My Lord :*
Baroness .	*Madam :*
Baronet .	*Dear Sir Edward Jones,* or, if you are on more familiar terms, *Dear Sir Edward :*
Bishop .	*My Lord Bishop :*
Cardinal .	*Your Eminence :*
Countess .	*Madam :*
Dean . .	*Very Reverend Sir :*
Duchess .	*Madam :*
Duke . .	*My Lord Duke :*
Earl . .	*My Lord :*

King .	*Sire :*
Knight .	*Sir, Dear Sir Harold, Dear Sir Harold Smith :*
Lord Mayor .	*My Lord :*
Lord Mayor's Wife.	*My Lady :*
Lord Provost	*My Lord :*
Marchioness .	*Madam :*
Marquess .	*My Lord Marquess :*
Mayor .	*Sir :*
Member of Parliament.	No special form of address unless the Member holds a rank or title.
Prince .	*Sir :*
Princess .	*Madam :*
Queen .	*Madam :*
Viscount .	*My Lord :*
Viscountess .	*Madam :*

Note.—The above are correct salutions for letters only, in speech generally the correct form of address is fuller and more descriptive, for example, you would address a Duke as "Your Grace" and a Duchess as "Your Grace." In writing you will note that the Duchess is addressed "Madam" in common with most feminine titles.

The Heading

You have now come to the beginning of the letter proper. If it is a business letter you may next wish to write a subject heading which would go in the centre of the page in the line immediately below the salutation. It would normally be something like this.

Re *Purchase of Bracken Mount Estate.* "Re" means referring to or in connection with.

With a personal letter, however, you will not normally insert any heading here. As you know at the beginning of every paragraph in any piece of writing, whether a letter or not, you indent, that is to say you commence a little further in than the normal margin of the paper. In the case of a letter the first line of the body of the letter under the salutation is indented a little further than the normal paragraph indentation. This will generally mean that it begins almost under the end of the salutation itself.

Avoid Unnecessary Tricks

For the sake of clarity and bearing in mind always that the primary purpose of writing anything is to convey a meaning to your reader, you should break up the matter into paragraphs. In a letter it is almost better to have too many than too few. Make sure your lines run straight across the paper and leave a reasonable space between the lines. You may remember when you were first at school that you could only achieve this by writing in a ruled copy book; even some adults find it an advantage to use a heavily ruled guide paper under their notepaper. The lines show through the opaque paper and can be written on as though it were a copy book. They do not, of course, appear in the letter which you actually send away.

Elsewhere in this chapter we shall have something to say of punctuation marks, but it is good to remember here not to use punctuation tricks in your writing such as underlining a word two or three times, or suddenly spelling the whole of a word in capital letters. You should rely on the clear way in which you string your words together to give any particular word emphasis, or stress. When you underline, or do anything of that sort it is as much as to say, "Please look at this word, I have said something funny," or "I have said something VERY important." This is quite unnecessary.

When you come to the end of the letter, there are definite forms and customs to be observed just as there were at the beginning.

Ending a Letter

The formal end of a letter is called the "subscription," which simply means the "writing under." Indeed,

many years ago the subscription used to begin with the words, "I now subscribe myself" and so on. Now we simply begin the subscription "Yours sincerely" or whatever the appropriate word may be. It is occasionally permitted to insert the words "I remain," but such a subscription is now almost as old-fashioned as "I subscribe myself."

In writing to a member of the family the most strictly appropriate wording would be "Yours affectionately" or "most affectionately," but this is often varied to "Your loving daughter," "your affectionate niece," and so on. Sometimes if the mood of your letter is intended to be more than usually affectionate, you should use a subscription on these lines: "I am, dearest Aunt Jane, your affectionate nephew, Richard."

When writing to friends, other than family friends, you will normally subscribe yourself, "Yours sincerely," "Yours very sincerely," or "Yours most sincerely." To a person whom you know but slightly, and this would cover most business communications, you will put "Yours truly," or "Yours faithfully," this latter being more generally used nowadays. Then comes your signature.

Signature

You will, of course, sign yourself with your Christian name only to all your family and to your most intimate friends. To the rest, you will sign your full signature. This is not necessarily your name in full. Thus, *Alfred Walker Smith* may sign *A. W. Smith*, *Alfred W. Smith* or even *A. Walker Smith*, just as he prefers.

A signature is a distinctive thing, and your very own. You must do it your own way. You should not, however, in your desire to make it specially distinctive, allow it to become either illegible or ridiculous. You know your own name; perhaps the other person doesn't.

Postscripts

Perhaps after you have re-read your letter and before putting it in its envelope, you decide that there is something else you ought to have said. Whatever you do, don't go back into the middle of the letter, and try to squeeze the extra bit in between the existing lines, or to write it up and down the margin. There is a proper place for such an afterthought. You put it in a paragraph by itself after your signature, beginning with the letters "P.S." This stands for "postscript," a word with a Latin origin, meaning written after, which is, of course, precisely what it is. If, by any chance, you have yet another afterthought—which, if you are concentrating should not normally be so, you begin this second postscript, "P.P.S."

You should never deliberately put a postscript on a letter; use it because you have forgotten something or because an extra bit of information which you want to convey has come into your possession after finishing a letter. The deliberate use of postscripts is an affectation which is just as unnecessary as tricks of speech or affectations of dress.

The Envelope

Always remember to check through your letter before finally folding it and placing in an envelope for posting. If you have said in the letter that you are enclosing something with it make sure that the enclosure is there. Fold your letter carefully and not too often—just often enough to enable it to fit neatly into the envelope. Every unnecessary fold makes it less easy to handle and read when it is received.

The address on the envelope follows very much the same form as the heading at the top of the right-hand corner of your letter. On the letter, of course, was your address, on the envelope is the name of the addressee

A SCHOLAR OF THE MIDDLE AGES

Before the invention of printing between the years 1440 and 1450 all books were written and copied by hand. In the picture above a famous scholar and penman of the Middle Ages, Jean Mielot, is seen at work writing on parchment, then regarded as a great art as such books were not merely executed in beautiful lettering but were often illustrated with exquisite designs and drawings.

—that is, the person to whom you are writing. It should take the following form:

Mrs F. Buck,
The Haven,
Westdene,
Dorset.

You will notice that the address is "staggered," that is to say, it goes down like stairs from top to bottom. This is not merely a custom; it is done to make each line as clear as possible to the Postal Authorities. Try the simple experiment for yourself, of writing an address straight down, one item directly under the other; you will see that it would be more difficult for the staff of sorters in the post office to pick out speedily the town, the road and finally the actual house.

For the same reasons of clarity the address should be written squarely in the middle of the envelope, bearing in mind that a stamp will go on the top right-hand corner, and in addition to the stamp the cancellation markings made by the Post Office. If you address the envelope too high and too much to the right the address will be obscured by these markings.

Your letter is now ready to post.

Postcards

Postcards in general use are of two types: plain postcards and picture postcards. The plain postcard is addressed exactly the same as a letter on one side; on the other it should bear the sender's address, but in practice the salutation may be dropped and the

subscription omitted. The postcard is in any case an informal means of corresponding and the strict form of the letter need not be adhered to. It is quite obviously not used for communications of any great importance or of a private nature, because at any stage of its journey, its message is open to be read by others.

In the case of the picture postcard the reverse side is divided into two halves. On one side goes the address, on the other the message. Do not allow your desire to say more than you have room for tempt you to carry your message across into the address section. This is not fair to the postal authorities. If you have so much to say, you should write a letter.

Telegrams

A telegram is really a shortened, abbreviated or condensed form of letter. You may send a telegram in two ways. If you are a telephone subscriber, all you need do is to get on to the telephone exchange, ask for "Telegrams," then proceed to dispatch it. You will be required to give your own telephone number, then the telephone number or address of the person to whom you are sending it. You then dictate your short message clearly, spelling any unusual words. You finish by giving your "signature." A telegram is meant for speed, therefore the shorter it is the more quickly it will go because there is less delay in its transmission. Bear in mind that after you give it to the telephone exchange it is sent over the telegraph lines to the receiving office nearest to your friend's address. A telegram is of course more expensive than a letter.

In a telegram there is no need to write beautiful smooth-flowing or even strictly grammatical English; you merely wish to give the essentials in a way in which they cannot be misunderstood. For example, in a letter you might say "You will be extremely pleased to hear that as a result of all my careful studies this term, I have been placed head of the form in the examination and have therefore gained a scholarship to York University." In a telegram all you need say is "Gained first in term exam., and York scholarship."

Transmitted by Radio

The alternative method of sending your telegram is to go into a post or telegraph office and ask for a telegram form. You then write your message on the form which is clearly laid out so that you cannot mistake its purpose, and hand the form to the clerk or operator, who will count the number of words (including the address of the person to whom you are sending it) and calculate how much it is going to cost you. The actual rate has varied at different periods in the history of the Telegraph Service and may do so again. A minimum charge of 1s. 6d. for twelve words and 1½d. for each word thereafter is the rate for inland telegrams at the time of writing The minimum charge means that even if the address and message is less than a total of twelve words you still pay as though it were twelve words. It is worth noting that, in calculating the number of words, a town, the name of which is really two words, normally counts as one. For example, West Malling, East Kilbride.

When a telegram, or as it is often called in ordinary conversation, "a wire," is sent to some place overseas, it is usually called "a cable." The word, of course, really refers to the under sea cables or lines along which the message is transmitted. Although to-day most cables are really telegrams transmitted by radio, they are still generally referred to as cables.

When you have written a letter, put it in its envelope, addressed, sealed, and stamped the envelope, you have then to post it. The action of posting a letter, so far as you are concerned, is

the end of the matter. It is a great tribute to our postal services that people everywhere take so much for granted the slipping of a letter into a letterbox. It never occurs to us that it will not reach the person for whom it is intended ; and how rarely does it ever fail to get there. When it is lost in the post it may well be that it has been badly or carelessly addressed, that the envelope has not been properly closed or even that the mail bag containing that particular letter has been stolen or destroyed by accident.

How Letters Reach their Destination

On the pillarbox or post office you will see a little notice showing the hours of collection. This indicates when the postman empties that particular box. He collects all the contents of the box at these particular hours and takes them to the main post office in the district. There they are sorted out, conveyed to the railway station in fast motor mail vans and placed on the mail train. Important mail trains actually have a post office as part of the train. In this a staff sorts out the thousands of letters and sees that they are delivered from the train at the proper stations in order to link up with other trains and finally reach the town to which they are addressed.

You may have heard of a pigeon post. In the modern world this is no longer really necessary, but there was a time when the sending of letters neatly rolled and tied to the leg of a homing pigeon, was a useful and quick form of dispatch. Homing pigeons are still used as a sport and in wartime they even came back into their own as carriers of messages when other forms of communication could not be used.

Express and Registered Letters

If you want to send your letter to-day, that is to say, a fairly long and detailed message, not a mere telegram, you may use a system known as "Telephone letter." Here you dictate your message to the telephone exchange who transmit it, probably during the night. At the other end it is again written down and delivered by a telegraph messenger. The despatch of a letter can always, of course, be speeded to some extent by sending it "Express." This means that it will not wait for a normal delivery of post when it arrives but will be sent out immediately by a special messenger.

If your letter is particularly valuable and you cannot afford to have it lost, or if you want to have a proof that you posted it, you may "register" the letter. You must go to a post office to do this. You will receive a receipt for the letter and the post office will accept responsibility for its safe delivery. There are additional rates of postage for Expressing or Registering a letter.

Short Cuts to Good Spelling

Some people naturally find spelling easy. They have what is known as a photographic memory for written words. When they see a word written they are impressed not only with its meaning but with its very shape. They see it in their mind's eye.

Other people just as naturally have no visual or photographic memory of this sort, although they may have a wonderful memory for the sound of a spoken word and perhaps quick and fine perception of a word's inner meaning. To such people spelling errors will be all too easy. For them, alas, and there are many of them, English is a most unkind language. So many of its words are not written at all as they are spoken. So many of its letters are silent, so many have sounds that vary from one word to another, and there are so many rules continually broken, that unless you have a strong photographic memory you are almost certain to make some spelling errors in English.

In the following paragraphs we are going to mention some of the com-

moner spelling mistakes and indicate some short cuts, or rules, that may help you to write them correctly.

Double Consonants

Very often double consonants have the same sound as a single consonant. For instance, gh may have the same sound as g (ghastly), or c as ch (chaos), or t as th (thyme). And there is, of course, the famous double consonant, ph which is pronounced neither like a p nor an h, but like an f (Phyllis). But the kind of double consonant that gives most trouble should perhaps be called the twin consonant. This is brought about by the adding of suffixes, or endings, to words. For example—bit, bitten, although the consonant has been doubled, the sound has not really changed. Some words, of course, have twin consonants, although there is no suffix added. Compare paper with pepper. Here are some rules for dealing with the double, or twin, consonant.

1. If you are adding a suffix which begins with a vowel, for example, *-ing*, or *-ed* to a word of one syllable, which itself has a single vowel followed by a final consonant, this final consonant is doubled. For example, blot, blot*ted*, blot*ting*.

2. The final consonant is not doubled if the word ends in two consonants, or if it has a double vowel before the final consonant.

For example: roast, roast*ing*; bleed, bleed*ing*.

3. In the case of words of more than one syllable ending with a consonant, this consonant is doubled if preceded by a single vowel and if the accent is on the last syllable.

For example: rebut, rebut*ted*.

4. The consonant is not doubled when the last syllable is not accented or stressed.

For example: fillet, fillet*ed*; benefit, benefit*ed*.

5. After a final *l* when a suffix begins with a vowel, the *l* is usually doubled, even when the accent does not fall on the last syllable.

For example: marvel, marvel*led*.

6. If a final *l* is preceded by two vowels, the *l* is not normally doubled before a suffix beginning with a vowel.

For example: feel, feel*ing*.

Note.—Two well-known exceptions which simply must be learned and memorised: woollen and parallel*ed*.

7. Words ending in double *ll* are interesting when a suffix beginning with a consonant is added. Sometimes one of the *l*'s is dropped, sometimes it is retained. Ill retains the double *l* in illness, but loses one of its final *l*'s in wilful. The double *l* is nearly always kept before the suffix *ness*. Still, still*ness*, full, full*ness*, chill, chill*ness*. Single *l*'s are not doubled before the suffixes *-ish*, *-ism*, *-ist* and *-ment*.

For example: devil, devil*ish*; real, real*ism*; moral, moral*ist*; fulfil, fulfil*ment*.

8. When words end in *s* to which a suffix beginning with a vowel has to be added, there is no definite rule as to whether the *s* is doubled or not. Generally, however, the *s* tends to double. Such plurals as bus*es*, focus*es*, atlas*es*, are not really exceptions to this tendency as they are words which have become English.

Words ending in a double *s* retain the double *s* when a suffix is added, whether it begins with a vowel or a consonant.

For example: bless, bless*ing* or bless*ed*; remiss, remiss*ness*.

Perhaps the second greatest difficulty in spelling English words is that two vowels may have the same sound. For example, ton and run. The O and U sounds, you notice, are identical. There are really no short cuts to mastering this difficulty. If you have the visual memory you will remember which vowel is used in which word, when you have seen it once. If you have not this sort of memory one of the best ways to aid it is to write a new word of this sort when you come across

it in your reading several times over until it becomes fully impressed on your mind. The word stomach, for example, has clearly a U-sound, yet it is spelt with an O. But there are, alas, confusing exceptions. For example, a B.B.C. announcer has pronounced the town Bromley, in Kent, Brumley. All of its natives would not agree to this, whereas, almost without exception, the town of Tonbridge in the same county, is pronounced as Tunbridge, not Tonbridge.

Another common source of spelling errors is the fact that many of our words are not really English at all. They are borrowed from foreign languages which may not even use the same alphabet as English. Obviously, so far as English is concerned, their spelling is an artificial agreement. An excellent example of this is the Japanese word for suicide, "hara-kiri." This is usually pronounced harry-karry, and therefore it is often wrongly spelt "hari-kari" by people who have a half-knowledge of its origin. Such foreign importations, too, have just to be firmly and resolutely written and re-written until the correct spelling becomes a habit. But here are some other groups of spelling difficulties to which some sort of rule can be applied, although there are nearly always exceptions.

(*a*) A spelling rule which nearly everybody knows as well as they know the rhyme about the days of the month: "Thirty days hath September, etc.," is this:

"I before E except after C."

The ie or ei combination in words is fraught with difficulty. The rule is little more than a guide. Here, for example, is a list of common exceptions

Ancient.	**Sufficient.**
Efficient.	**Deficient.**
Inveigh.	**Weigh.**
Neither.	**Sleigh.**
Reign.	**Rein.**
Foreign.	**Height.**
Deign.	**Their.**

There are, however, two sub-rules that can be applied to the exceptions.

(i) I before E except after C in words with the vowel sound double e. (Exceptions to this sub-rule are ***seize, weird, counterfeit.***)

(ii) I before E except after C, unless the C has an sh sound. The word ***fancied*** is an exception to this sub-rule.

(*b*) Should a verb end in ise- or -ize? A great English authority on words, Fowler, whose works you will probably study when you are older, almost excuses the difficulty of knowing which is which. Generally, words with a Greek or classical origin from the Greek ***izo,*** should end ***ize***—words like baptize and epitomize, but even they are frequently spelt even by good writers ***-ise.*** This is really copying the French manner. But here is a list of words, listed by Fowler, as correctly spelt *-ise.*

Advertise.	**Advise.**
Apprise.	**Chastise.**
Comprise.	**Compromise.**
Demise.	**Despise.**
Devise.	**Defranchise.**
Enfranchise	**Enterprise.**
Excise.	**Exercise.**
Improvise.	**Incise.**
Premise.	**Supervise.**
Surmise.	**Surprise.**

It is interesting to note that in America the -ize spelling has become almost as universal as the -ise spelling has in this country. As we have noted, a universal rule is, strictly, wrong in either country. The root origin of the word is the correct guide.

Tricky Word Endings

We have noticed the rules and exceptions regarding the spelling of words ending in consonants, particularly double consonants. But there are other sources of difficulty at the end of a word when a suffix has to be added. For example: *-ly* is an adverbial ending. There is an immediate problem when it has to be added to an adjective already ending in *l* or *ll.* The rule to follow is simple. After the

ending has been added, the resulting adverb should end in *-lly* whether the original word had one *l* or two. *Bountiful* gives *bountifully*; *full, fully*; *doleful, dolefully*, and so on.

A similar difficulty which can be remembered with the last one is the formation of a noun ending in *-ness* from an adjective which already ends in an *n*. The rule is that the word retains the *n*, resulting in a double *n*. *Thin*, gives *thinness*; *solemn, solemnness*.

Here is another tricky ending to watch. It applies to words which end in *e*, when a suffix beginning with a vowel has to be tagged on. The rule is that the single *e* is generally dropped. If the suffix begins with a consonant it is generally retained. *Rude*, gives *rudery* or *rudeness*. *Crude, crudity and crudeness*. There is one word in this connection which has been a puzzle to spelling authorities for years and the correct spelling is not yet fully settled by the experts. The word is *judgement* or *judgment*. You will notice it is formed by adding the suffix *-ment* to the word *judge*. According to the rule we have just quoted, since *-ment* begins with a consonant, the *e* should be retained. Most dictionaries give the form *judgment*, and consider it the exception that proves the rule. Some experts justify the dropping of the *e* on the grounds that the *e* is not necessary to help the correct pronunciation. It has even been suggested that the meaning of the word *judgment* is so important and so separate that it is well not to associate it too closely with the root word *judge*. In the case of a word like this, the great thing is to be consistent. Think about it, ask one or two people whose opinions you respect, then decide which version you will adopt. Having done so, you should always spell it that way and abide by your *judgment*.

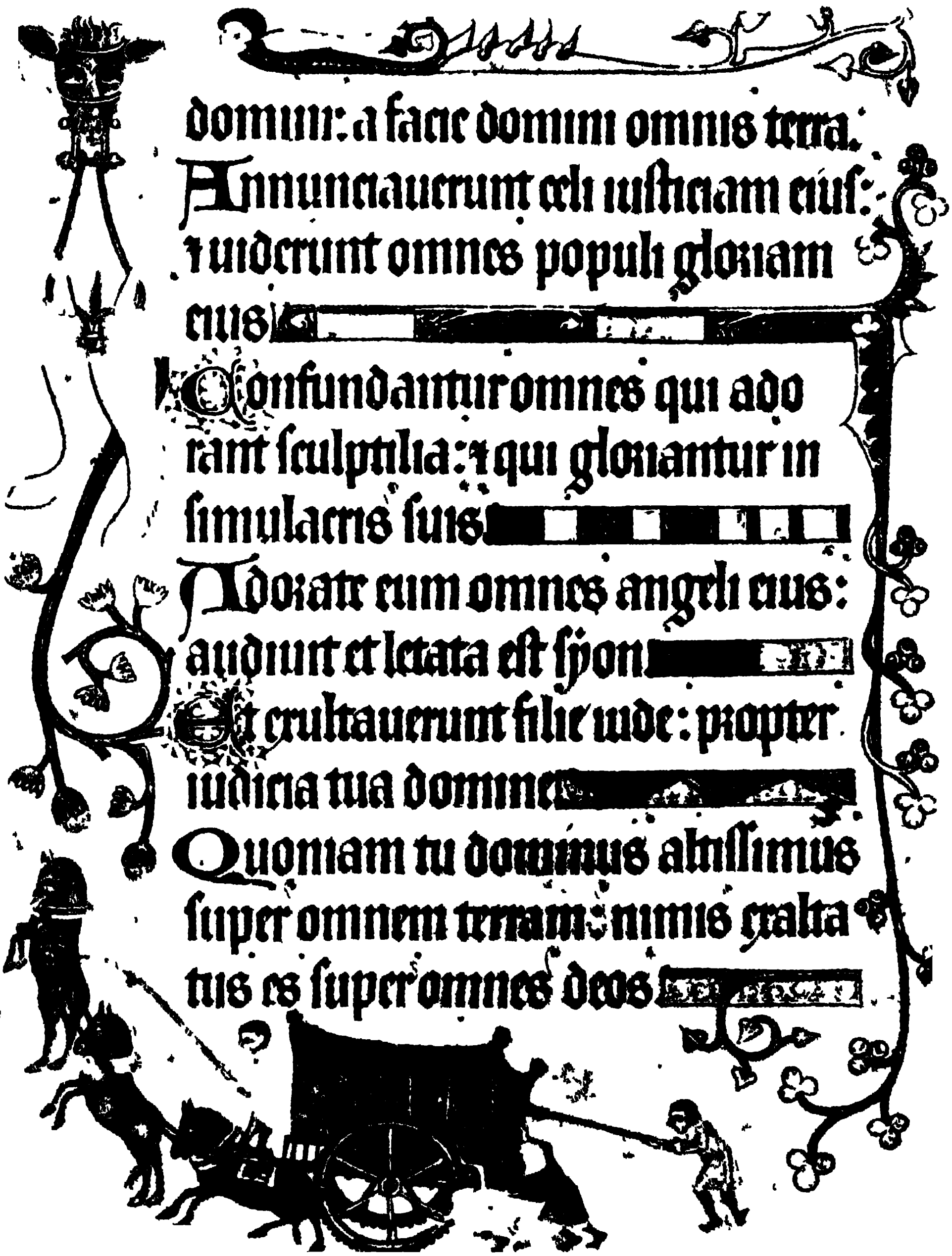
There are, however, exceptions to the dropping-of-the-e-rule, about which there is no argument. *Singe* becomes *singeing* (singing obviously wouldn't do). *Notice* becomes *noticeable* to help the pronunciation (the c might otherwise become hard). For the same reason *gauge* becomes *gaugeable* and *whole, wholly*.

If the word ends in *ie* and the suffix *-ing* has to be added, the *ie* becomes *y* (exception, *hie* becomes *hieing*). Notice *die, dying*; *dye, dyeing*. Words ending *ye, oe, ee* retain the final *e* before *ing, fleeing, shoeing, eyeing*. If a word ends in a *y*, the *y* becomes *i* unless the suffix begins with *i*. *Parry*, becomes *parried* or *parrying*. If *y* ends the word, following a vowel, this change does not take place. *Enjoy* becomes *enjoyed* or *enjoying*. (Exceptions, *say, said*; *pay, paid*.)

Plurals

A Latin word like radius becomes rad*ii*, whereas the word bus (really the Latin word omnibus) has the plural bus*es*. These two examples suggest the general rule. If the word has never really ceased to be classical, it is given a classical plural in English. If the word has become to all intents and purposes a native English word, it forms its plural in the native English way, namely, by adding *s* or *es*. Words of foreign origin ending in *o*, like *ditto, commando, crescendo*, add *s* only, to form the plural. Otherwise, " native " words ending in *o*, like *cargo, potato, hero*, add *es*. Where, however, the particular word already ends in two vowels, such as *folio and cameo*, *s* only is added. This is less a matter of logic than to avoid three vowels coming together. *Photo, piano, dynamo*, which are really abbreviations, add *s* only. It is interesting to note that if you have to use a single word like *no*, or *go*, in the plural, *es* is added, probably to make the word more acceptable.

Note these plural endings. *Phenomenon* becomes *phenomena*. *Premise* becomes *premises*, *rotunda* becomes *rotundæ*, but *stanza stanzas*. Index becomes *indices*. Note also a host


domini: a facie domini omnis terra.
Annunciauerunt celi iusticiam eius:
⁊ uiderunt omnes populi gloriam
eius.
Confundantur omnes qui ado
rant sculptilia: ⁊ qui gloriantur in
simulacris suis.
Adorate eum omnes angeli eius:
audiuit et letata est syon.
Et exultauerunt filie iude: propter
iudicia tua domine.
Quoniam tu dominus altissimus
super omnem terram: nimis exalta
tus es super omnes deos.

For the greater part of a thousand years before William Caxton set up the first printing press in England in 1476 77, the only books produced in this country were written by hand Most of them were the work of monks, and a fine example of their craftsmanship is seen in the photograph above of a page of the Luttrell Psalter, written about 1340 The passage shown here is a portion of Psalm 97, from the end of verse 5 to end of verse 9

of peculiar plurals which most people spell correctly because they are so common, *mouse, mice ; house, houses ; ox, oxen ; hoof, hooves ; loaf, loaves ;* but *sheep, sheep.*

Care should be taken about the plural of nouns ending in y. The rule is that the y becomes *ies*, unless it is preceded by *e* when the *ey* simply has the *s* added to become *-eys*. Poppy becomes popp*ies*, but storey becomes storey*s* as distinguished from story, stor*ies*.

The Prefix Al

When the word "all" is prefixed to another word to make a compound word, one of the l's is usually dropped. For example, already, almost, altogether. All right should always be written as two words. "Altogether" and "all together" have rather different meanings.

When the word "full" is used as a suffix, although there is apparently nothing to influence the final l, it is dropped. Hope becomes hope*ful*, beauty, beauti*ful*, care becomes care*ful*.

When "All" is the Ending

Here is a common source of spelling mistakes. You may have to look twice to decide whether the following words are correctly or incorrectly spelt. Appal, enthrall, install, befall. According to that great authority, the Concise Oxford Dictionary, the double l is necessary following the a, whereas words like distil, annul, following other vowels, show single l's. However, some good writers spell enthral with one l and the Oxford Dictionary breaks its own rule by spelling appal with one.

Adjectives ending in -ed

If a word ends in a vowel and you wish to use it as an adjective, with the -ed ending, for example, halo, halo*ed*, there is always a problem. As a general rule, however, add a single *d* if the word ends in a single vowel sound, e. For example, pedigreed, filigreed ; add *-ed* if it ends otherwise.

What is a Diphthong ?

Œ and Æ are diphthongs. They are really clumsy and unnecessary in modern English. Indeed, in the case of many words originally spelt with a diphthong it is now an affectation of writing to use the diphthong. Ether was originally Æther. Medieval was mediæval. There is some reason, however, for retaining the diphthong, with such foreign arrivals to the language as hors d'œuvres.

Some Prefix Difficulties

The most frequently mis-spelt prefix is *un* or *in*, meaning not. If a rule can be given at all, it is this. Words of Latin origin, take *in*. Words of native English origin, *un*. But, alas, this rule is very frequently broken, and formations, even with the same root, are not consistent. Digest, for instance, gives you undigested, but indigestible. The best way here, as with so many of our spelling difficulties, is to try and photograph the correct form in your mind. Here is a short list of common words showing the correct *in* or *un* prefix.

*In*admissible.	*Un*acceptable.
*In*adaptability.	*Un*adaptable.
*In*applicable.	*Un*alterable.
*In*appropriate.	*Un*apparent.
*In*cautious.	*Un*charitable.
*In*civility.	*Un*congenial.
*In*conceivable.	*Un*considered.
*In*considerable.	*Un*controllable.
*In*consolable.	*Un*corrupted.
*In*distinct.	*Un*deniable.
*In*distinguishable.	*Un*distinguished.
*In*efficient.	*Un*escapable.
*In*explicable.	*Un*expurgated.
*In*flexible.	*Un*grammatical.
*In*gratitude.	*Un*grateful.
*In*hospitable.	*Un*objectionable.
*Ir*opportune.	*Un*obliging.
*In*quietude.	*Un*quenchable.
*In*sanitary.	*Un*scientific.

*In*soluble.	*Un*sociable.
*In*susceptible.	*Un*substantial.
*In*surmountable.	*Un*successful.

Notice particularly the prefix *in* when it means "in" rather than "not." It has variations, *im* (usually for reasons of sound, *im*merse) and *en* or *em*. Here are a few words to study. We give the spellings generally accepted as correct, though the alternative is not always wrong.

*In*quire.	*In*ure.
*In*grain.	*En*treat.
*En*trust.	*En*mesh.
*En*sure.	*In*sure (business).
*En*dorse.	*En*case.

A particularly difficult prefix to handle is *for* or *fore*. The trouble is that the prefix has a large number of different shades of meaning It does not always imply going before in time or order or rank. When it does imply this sense of order it generally takes the form ending with the e. For example . forehead, forearm, foremast, forefather (ancestor). When the meaning is slightly away from the idea of priority, the *for* form is more general. But the *for* words are rare and are tending to fall out of use. Forgo means to go without rather than to go before, hence the absence of the e. Forbid suggests exclusion, not priority. Forbear suggests abstinence. Forget, forgive, forlorn, forsake, forsooth, forswear, likewise have no sense of priority.

Foreclose is an interesting exception with which to end this group of words. To follow our rule it should have been *forclose* because it suggests exclusion rather than priority.

Ante or Anti ?

The prefix *ante* means before, whereas *anti* means opposed to or against. If you bear these meanings in mind you will not readily mis-spell words like *anti*septic (opposed to or against sepsis or poison), *ante*diluvian (before the flood, or ancient). The word *anti*macassar might not immediately help you until you think of its fundamental meaning "against or opposed to macassar oil." Hence a covering over the back of the chair to protect it from hair-oil.

Some More Common Confusions

There are some word endings so much alike that they give rise to frequent spelling mistakes, all the more so because in many cases it is difficult to lay down a definite rule

-xion or ction. The tendency nowadays is to prefer the ending *ction* in words like conne*ction*, defle*ction*, infle*ction*, and refle*ction* although from the etymological point of view, that is, having regard to the root of the word, the "x" spelling is more correct. Even the more important standard dictionaries are at variance in regard to these noun endings. You would not be wrong to use "x" indeed, you might be more academically correct, but the *ct* form has the greatest support in common journalistic and literary usage.

-In or -Ine. Words like gelatine, margarine and insulin, all have a scientific origin, and the variation in spelling is based on a scientific rather than grammatical principle. Neutral substances are spelt *-in*, basic substances *-ine*. Ordinary people, with no special scientific knowledge will, perhaps, however, find little help in this rule , as so often in English, they will just have to try and fix the correct form in their minds.

-Or or -Our. You may have noticed that English words like humour, odour, and clamour are spelt in American writing humor, odor, clamor. We are rather inclined to criticise the Americans for what we regard as a modern short-cut version, but we are on rather delicate ground here, for we ourselves consider we are correct in writing stup*or*, trem*or* or the very common horr*or*. The Americans are at least consistent. Some day we may imitate

their consistency without feeling that we are losing the dignity of our language. In the meantime we keep the "u" in such words as col*our*, and vap*our*, but we drop it when we make the noun coloration, the verb vaporise, or to revert to our earlier examples, the adjectives odor*ous*, humor*ous*, clamor*ous*.

-Ey or -Y. One of the first and simplest efforts at word-making which a child learns, is to make an adjective out of a noun by giving it a -y ending. You talk of a green-y colour when you mean it is slightly green. The -y not only forms an adjective but tends to minimize or reduce the force of the noun. The spelling problem comes with words like mouse, nose, stage, blue. A silent "e" at the end of a word is usually dropped when the "y" ending is added. Thus we get the adjectives mousy, nosy, stagy. With blue, however, the "e" is retained because it is really part of the "ue" and in that sense is not silent. By contrast the word plague becomes plag*uy*, because the *ue* is silent.

When the noun already ends in a y, *-ey* is added: clay giving clay*ey*.

Able or -Ible

Able or -Ible. Unfortunately, no authority has yet provided a really good short-cut to good spelling so far as the adjectival endings *-ible or able* are concerned. We therefore are giving you a list of the commoner words in pairs, to provide a contrast that may help you to remember which are the "a"s and which are the "i"s.

-ABLE WORDS	-IBLE WORDS.
Accept*able*	Access*ible*
Account*able*	Adduc*ible*
Approach*able*	Admiss*ible*
Believ*able*	Comprehens*ible*
Blame*able*	Contempt*ible*
Break*able*	Destruct*ible*
Convers*able*	Convert*ible*
Debat*able*	Deduc*ible*
Describ*able*	Discern*ible*
Dispens*able*	Divis*ible*
Excit*able*	Illeg*ible*
Excus*able*	Express*ible*
Govern*able*	Dirig*ible*
Indefatig*able*	Invinc*ible*
Insuper*able*	Incorrig*ible*
Lament*able*	Irasc*ible*
Limit*able*	Expans*ible*
Lov*able*	Leg*ible*
Manage*able*	Neglig*ible*
Notice*able*	Ostens*ible*
Pass*able*	Plaus*ible*
Penetr*able*	Percept*ible*
Presum*able*	Permiss*ible*
Reconcil*able*	Reduc*ible*
Respect*able*	Respons*ible*
Refut*able*	Resist*ible*
Return*able*	Revers*ible*
Reput*able*	Ris*ible*
Sale*able*	Sens*ible*
Service*able*	Suscept*ible*
Trace*able*	Tang*ible*
Vulner*able*	Vis*ible*

A Spelling "Dictionary"

Here follows a short list of words which have been proved by teachers and printers and writers to be easily mis-spelt. Some of them we have mentioned already in connection with particular rules or difficulties, but they are here given in alphabetical order for your quick reference. (If you are having a Spelling Bee or a Quiz with a spelling question, this list will give you a fine selection of test words.)

Abbot
Abbreviate
Abdicator
Abductor
Aberration
Abridgement
Abscess
Absence
Absinthe
Abstemious
Abundance
Abyss
Accelerate
Accessary (of persons)
Accessory (of things)
Acclimatize
Accommodate
Accompanist
Accordion
Accrue
Acetic (acid)
Acknowledgement
Acoustic
Acquiesce
Acquire
Actuary
Addressee
Adducible
Adieu
Adjectivally
Adjudgment (but *Adjudgement* permissible)
Adjudicator
Adjunct
Admissible
Adulatory
Adventitious
Advertisement
Advisable
Æolian
Æon
Aerial
Aesthete
Affiliation
Affright
Ageing
Agglomeration
Aggrandizement
Aggravate
Aggregate

Aggression
Aggrieve
Agitator
Agriculturist
Aileron
Ajar (door)
A-kimbo
Albatross
Albinos
Albumen
Albuminous
Alfresco
Alibi
Ailment
Alimentary
Allegeable
Alligator
Alliteration
Allocation
Allot
Allotted
Aluminium
Amanuensis
Ambidextrous
Amiable
Amphibious
Anæmia
Anæsthesia
Analogous
Analyse
Ancillary
Annul
Anoint
Anomalous
Anonymous
Antarctic
Antediluvian
Anteroom
Antimacassar
Antimony
Antirrhinum
Antiseptic
Aping
Apoplectic
Apostrophe
Appal
Apparatus
Apparel
Apparent
Appellant
Apposite
Aqueduct
Aqueous
Archipelago
Arctic
Armadillo
Ascendance
Ascertain
Ascetic (austere)
Asphalt
Assassin
Assess
Assurer

Asthma
Augur (prophet)
Auger (tool)
Aurora Borealis
Auxiliary
Avoirdupois
Awesome
Awful
Ayah

Bagatelle
Baksheesh
Balanceable
Balloted
Balustrade
Bandoleer
Banister
Banqueting
Barcarole
Baritone
Barrel
Battalion
Bayonet
Beatitude
Believable
Benzene (spirit distilled from coal gas)
Benzine (spirit obtained from petroleum)
Bevelling
Biannual (twice a year) dist from Biennial (every two years)
Biasing
Bilberry
Binnacle (Compass stand)
Binocular
Bivouacked
Bizarre
Blancmange
Bogy (ghost)
Bogey (golf)
Bogie (truck)
Boycott
Brochure
Broccoli
Bucolic
Budgerigar
Bulldog
Bulrush
Bulwark
By and by
By the bye

Caddie (golf)
Caddy (tea)
Calendar (almanac)
Calender (to smooth)
Calibre
Camaraderie
Camellia
Cannonade
Canonical
Canvas (cloth)
Canvass (solicit)
Capercailzie (bird)
Carburetter
Carcass
Caress
Caste (class)
Castellated
Cataloguing
Catarrh
Catechism
Caterpillar
Cauliflower
Cemetery
Centenary
Centring
Chameleon
Chandelier
Changeable
Chauffeur
Chiaroscuro
Chilblain
Chord
Chrysalis
Chrysanthemum
Cider
Cinnamon
Cipher
Clangor
Clayey
Clientele
Clique
Colander
Collaborator
Colloquial
Colonnade
Colossal
Commemorate
Commingle
Committed
Committee
Commonalty
Communal
Complement (that which completes)
Compliment (flattery)
Condign
Confectionery
Connection
Connoisseur
Conscientious
Contagious
Corollary
Corroborate
Courageous
Creche
Creosote
Courtesy

Crochet (knitting)
Crotchet (music)
Crustaceous
Curtsy

Daguerreotype
Dais
Dandelion
Debatable
Deceased (dead)
Deciduous
Defendant
Deflection
Deified
Demesne
Derogatory
Descendant
Desiccate
Dilapidated
Dinghy
Diphtheria
Dirigible
Disappear
Diseased (ill)
Dissimilar
Dissociate
Doggerel
Doily
Dullness

Ecclesiastical
Echelon
Ecstasy
Eczema
Edelweiss
Effervescence
Eisteddfod
Ellipsis
Embarrass
Embed
Emissary
Empanel
Enmesh
Ensconce
Ensure
Envelopment
Erasure
Erroneous
Erysipelas
Escutcheon
Etymology
Eulogize
Euphuistic
Exacerbation
Exaggerate
Excrescence
Exercise (practice)
Exorcize (drive away)
Exhibitor

Exhilarate
Exonerate
Exotic
Expense
Extempore
Extraordinarily

Facetious
Facsimile
Fakable
Fascinate
Fiasco
Fidgeting
Filleting
Fillip
Finicking
Flaccid
Flannelette
Flannelled
Fledgeling
Flexible
Florescence
Forbear (verb)
Forebears (ancestors)
Foreclose
Forfeit
Foully
Frolicking
Fuchsia
Fugue
Fulfil
Fumigator
Furze
Fusilier

Galaxy
Gallivant
Gambolling
Gaol
Gaseous
Gasolene
Gauge
Genuflexion
Germane
Geyser
Ghastly
Gherkin
Ghetto
Ghoul
Gillie
Gladiolus
Gluey
Glutinous
Glycerine
Gnome
Grandeur
Gruesome
Guerrilla
Gorilla
Guillemot
Gymkhana
Gymnasium
Gypsy
Gyrate

Habiliment
Hæmorrhage
Halcyon
Half-caste
Halibut
Handkerchief
Hara-kiri
Harangue
Harass
Hare-brained
Headachy
Heifer
Heighten
Heinous
Herbaceous
Hereditary
Heterogeneous
Hiatus
Hiccup
Hieing
Hinging
Hirsute
Holocaust
Honorarium
Hoopoe
Hoping
Horoscope
Horsy
Hullabaloo
Humorist
Hyacinth
Hydrangea
Hygiene
Hypocrisy

Icicle
Idiosyncrasy
Immanent
Impeccable
Impresario
Impromptu
Inaugurate
Incidentally
Indelible
Independent
Indictment
Infallible
Infinitesimal
Inflection
Inflexible
Ingenious (clever)
Ingenuous (innocent)
Inimical
Innocuous
Innuendo
Inoculate
Inquire
Install
Insular
Insure
Integer
Interrogate
Interstice
Intriguing
Inure
Inveigle
Ipecacuanha
Isosceles
Isthmus
Itinerary
Ivied
Ivory

Jeopardy
Jocose
Jocund
Jugglery
Juiciness

Kaleidoscope
Kedgeree
Kennel
Kernel
Khaki
Kudos

Labyrinth
Lackadaisical
Lacquer
Lager
Lagoon
Lama (Buddhist priest)
Llama (animal)
Languor
Laryngitis
Lassitude
Lassoing
Legerdemain
Leprechaun
Leprosy
Liaison
Librarian
Licence (a permit)
License (verb to permit)
Liege
Lieutenant
Lineage (ancestry)
Liniment (embrocation)
Linguistic
Linoleum
Liquefy
Liqueur
Liquorice
Lissom
Literal
Lode.tar
Loggia
Longevity
Lorry
Lousy
Luscious
Lustre

Macaroon
Machinery
Mackerel
Maelstrom
Magenta
Magneto
Mahogany
Mahout
Manacle
Mandible
Mandolin
Maniac
Manikin
Mannequin
Manœuvre
Margarine
Marmalade
Mashie
Massacre
Mayonnaise
Mazy
Medicine
Medieval
Meerschaum
Meringue
Meter (measuring instrument)
Metre (rhythm)
Millinery (hats)
Millennium
Millepede
Millionaire
Mimicking
Miniature
Miscellaneous
Mischievous
Mis spelt
Mizen
Moccasin
Moiety
Monocle
Mosquito
Moustache
Mousy
Mulligatawny
Myopia

Naive
Nasturtium
Nausea
Necessarily
Negligible
Nicety
Niece
Nincompoop

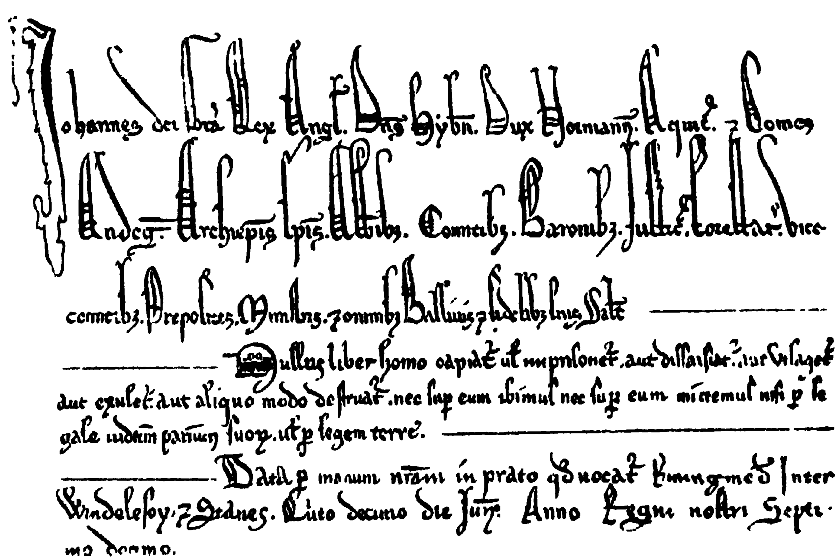
Oasis
Obbligato
Obedient
Obese
Oboist
Obscene
Observatory
Obsession
Obsolete
Ochre
Odorous
Odyssey
Offence
Offensive
Offertory
Olfactory
Ominous
Omission
Omniscient
Oneself
Opossum
Opposite
Orangeade
Ordinance (rule)
Ordnance (cannon)
Orgy
Oscillate
Ossified

Paging
Palette
Palfrey
Palliasse
Panacea
Papyrus
Paraffin
Parallel
Parallelogram
Paralyse
Paraphernalia
Paroxysm
Parquet
Passable
Pebbly
Pedalling
Pedlar
Peewit
Pencilling
Peninsula
Penniless
Perceive
Perennial
Perfunctory
Permissible
Perquisite
Personnel
Petroleum

Petulance
Phenomenon
Phlegm
Phosphorescence
Phosphorus
Physicist
Physique
Pianoforte
Piccaninny
Piccolo
Picaresque
Plague
Plain-sailing (*fig.*)
Plane-sailing (*naut.*)
Plausible
Plebeian
Pleurisy
Poignancy
Pomegranate
Possess
Postilion
Potato
Practice (noun)
Practise (verb)
Precedent
Prestige
Pretence
Pretension

Primeval
Principal (chief)
Principle (law)
Prise (force open)
Privilege
Proffer
Propaganda
Propeller
Prophecy (noun)
Prophesy (verb)
Propitious
Proscribe (denounce)
Prescribe (set down)
Pseudonym
Psychology
Psychiatry
Ptarmigan
Pterodactyl
Ptomaine
Puerile
Pygmy
Pyjamas
Pyrotechnic

Quarrel
Quarreller
Quarrelsome
Quay



F. H. Crow

THE WRITING OF THE GREAT CHARTER

Handwriting has undergone various changes during the centuries, and in the illustration above are shown facsimiles of the writing in the original Magna Carta, to which King John set his seal at Runnymede on June 15th, 1215. Few written documents have been so important in establishing the rights of every man in this country to justice, no matter what his rank or position.

Querying
Queue
Quinsy
Quixotic
Quotient

Radiator
Radish
Raisin
Ransom
Ratio
Recognize
Reconnaissance
Reconnoitre
Reflection
Remembrance
Reminiscence
Renaissance
Reprieve
Resplendent
Resuscitate
Rhinoceros
Rhododendron
Rhubarb
Ricochetting
Rinse
Risible
Rissole
Rivalling
Rivalry
Rosiness
Rottenness
Rubicund

Saccharine
Sacrament
Sacrilege
Sacrosanct
Saddler
Sapphire
Satellite
Sceptic
Schottische
Sciatica
Scimitar
Scintillate
Scythe
Sedentary
Seize
Septic
Shako
Shallot
Shillelagh
Siege
Silhouette
Siphon
Siren
Sobriquet
Soliloquy
Somersault
Sootiness
Spongy
Spontaneous
Stationary (fixed)
Stationery (paper)
Stereotype
Stiletto
Stomachic
Stupefy
Stymie
Subpœna
Subterranean
Subtle
Succinct
Summary (short)
Summery (summer like)
Supererogatory
Supersede
Suspicious
Sycamore
Sycophant
Symmetry
Synonymous
Syringe
Syringeing

Tangible
Tattoo
Teetotaler
Teetotum
Termagant
Terpsichorean
Thieving
Thraldom
Titillate
Tobogganing
Tonsillitis
Tragedian
Tremolo
Tunnelling

Ubiquitous
Umbrella
Unctuous
Underrate

Veld (S Africa)
Velocipede
Venal (sordid)
Venial (pardonable)
Veranda
Vermilion
Veterinary
Vicarious
Vicissitude
Victualling
Vinegar
Violoncello
Virtuoso
Viscous
Voracity
Vying

Walrus
Wassail
Welsher
Whereabouts
Wherewithal
Whimsy
Wilful
Woebegone
Woollen
Wraith

Xylophone

Zigzagging

Punctuation

However well you form your sentences, however good your spelling, your grammar and your style, you cannot just write on and on, filling page after page without a stop.

Stops in your writing are known as punctuation, and while there are no hard and fast rules about punctuation that can be compared with grammatical or spelling rules, there are certain principles to be observed. If a piece of writing is meant to be read or spoken aloud the main purpose of punctuation becomes clear. The insertion of punctuation marks indicates the natural pauses that the speaker will have to make in order to convey the sense most lucidly. But writing even if it be meant to be read only—not aloud—should be punctuated as an aid to the better understanding of its context.

To-day, we tend to write short, crisp sentences terminated by full stop, or period. Fifty years ago, even the masters of English prose tended to write extremely long sentences, which compelled the use of the lesser punctuation marks, the comma, the colon, semi-colon and marks of parenthesis. There is no mathematical formula for the use of punctuation marks. Punctuation varies, as we have shown, from one age to another, and from one writer to another. You will even find in the works of one first-class writer of English an inconsistency in punctuation.

Once again, as we cannot repeat too often, in any attempt to explain the magic art of writing, the best way to acquire it is to study the masters.

The Full-stop (.). This is the basic punctuation mark the point. The word punctuation is derived itself from

the Latin word for point and you will notice its kinship with the word puncture. The full-stop ends a sentence. The next sentence begins with a capital letter and you will remember that it is generally considered bad style to commence a sentence with a preposition. Even this old and respected rule is, however, frequently broken in good modern prose.

The full-stop is also used at the end of a word which has been abbreviated or shortened. Such abbreviations tend, however, to become words in their own right, and the full stop is dropped. When the word department is spelt dept. the full-stop persists, probably because no one attempts to consider the abbreviation a word on its own.

Making Your Meaning Clear

The Comma (,). This mark of punctuation is very much overworked to-day. It might be described as the mark which indicates the shortest or slightest pause. It should not be used when the formation of the sentence produces breaks naturally. On the other hand, it should not be omitted if its inclusion makes a meaning clearer. Where a more definite break occurs, this should be marked by a semi-colon.

The Semi-colon (;). The very nature of this punctuation mark is an excellent indication of its proper use. It is at one and the same time a comma and a full-stop. Its value lies somewhere between the two.

The Colon (:). This punctuation mark is not very popular in modern writing. It is generally used to indicate the beginning of a list or of a quotation rather than as a mere sign of pause or break. It is, however, a valuable punctuation mark for making out of two short opposed sentences one well-balanced contrast. For example—" Mary is good : Jane is not."

Be Sparing with the Dash

The Dash (—). In modern journalism, if not in more literary writings, the dash is used frequently, as an easy alternative to the correct punctuation mark. You should try to use the correct mark, not the dash, because the dash has some special purposes of its own for which it is really useful in writing. (1) To show hesitation. The dash is most valuable in such a sentence as this. " Shall I say adieu—or au revoir." (2) To indicate the interruption, or a sudden turn of thought. " No one in the class—except Tom—would be so stupid." (3) To insert an explanation, " This book—PICTORIAL KNOWLEDGE—is designed to bring you success." (4) To create a surprise at the end of a sentence. For example, " He cried for water—and they brought him wine." (5) To sum up a list. " She possessed gowns, furs, jewellery—finery of every kind." (6) For parentheses, that is, a word or words inserted in a sentence which is grammatically complete without them. For example—" The Prime Minister—I saw him—was not smoking a cigar."

The use of dashes for parentheses in this way is not advised. There is a better alternative. Brackets can be used when the above sentence would become " The Prime Minister (I saw him) was not smoking a cigar." If brackets are used exclusively for parenthesis there can be no confusion. As shown by (1), (2), (3), (4), and (5), the dash has other uses. When a reader comes upon a dash, he may assume that a parenthesis has begun, only to discover that the final dash never appeared and that he is not, in fact, reading a parenthetical clause at all.

When to Use Inverted Commas

Quotation Marks (" "). These marks are generally referred to as " inverted commas." Their primary use is to introduce the actual words of a speaker. For example : John said " I shall arrive at noon." They are, however, also used to mark a passage taken from another book. In this use they are strictly quotation marks. In written

as distinct from printed English, inverted commas may also indicate the title of a book or play, or a picture, piece of music, etc. Thus: They listened to the "Moonlight Sonata."

The printer can avoid the necessity of using inverted commas in this way by using italic type: They listened to the *Moonlight Sonata.* Both in printing and writing inverted commas are used when a word is being quoted and not being used for its meaning in the sentence. For example: There are too many "don'ts" in Jimmy's conversation. Quotation marks have yet another purpose: to show that a word is not being used in its literal or usual sense. They watched the "shadows" on the cornfield. Without quotation marks this would imply that the shadows of clouds or trees were visible on the corn. With the quotation marks it may indicate the light and shade of the growing corn when moved by the wind.

Remember when addressing letters that the name of your friend's house need not go in quotation marks. Nor in general writing need the names of ships, aeroplanes, railway trains and so on, unless there is any risk of confusion. He saw it in "The Sun" would immediately indicate that he saw it in a paper called The Sun. Without the quotation marks one might be tempted to suppose that he had been making observations in a solar observatory.

Note. Single inverted commas are used for a quotation within a quotation. Example: John said, "I could just hear Frank call 'Let us go home,' and I knew they had finished."

The Apostrophe ('). The apostrophe has two uses in English writing: to indicate that a letter has been omitted, or to indicate the possessive.

The Play's the Thing is a good example of (1). Here the apostrophe is inserted to indicate that the letter i has been omitted from the words "play is." The use of the apostrophe for this primary purpose in words like don't, can't, shan't, is particularly interesting. It is, of course, strictly correct to use the apostrophe. There is, however, a tendency nowadays to omit it from cant and dont, which of course stand for "cannot" and "do not" but have become to some extent words on their own. Some writers including George Bernard Shaw have favoured the omission of the apostrophe. Care should be taken in spelling the word "its." This may mean either it is, in which case it should have an apostrophe--it's, or it may be the possessive of the pronoun it, in which case it does not have an apostrophe. "Its name is chocolate and it's good to eat."

In a Possessive Sense

The use of apostrophe 's at the end of a word to indicate the possessive, is with most singular words a very easy rule to follow. Instead of the "cap of the boy" you say "The boy's cap." When the word is in the plural, however, the apostrophe comes after the *s'*--the boys' caps.

Where a singular word already ends in s, it was previously the custom to make it possessive by adding an apostrophe without any further *s*. This still applies in English poetry, but in normal prose and current conversation we add the apostrophe 's. For example, St. James's Road.

The Question Mark (?). This punctuation mark explains itself. Its only proper use is at the end of a direct question. It has no other proper use in good written English. For example, you would not put a question mark at the end of the sentence "I asked him where he was going." You would, invariably, at the end of the direct question "Where are you going?" A question mark should never be used in the middle of a sentence to indicate a joke or make a doubting comment. For example, you would not write "Johnny has painted a picture (?) of a sunset." If you really wish to indi-

cate that Johnny's effort isn't really much of a picture, you can say so in many better ways.

To be Used With Care

The Exclamation Mark (!). Perhaps the best guide to the use of the exclamation mark at the end of your sentences is to say that it expresses emotion. It is a mark of bad writing to use too many exclamation marks. The words themselves will express all the emotion that is necessary in most cases. Exclamation marks should be used after interjections, such as ah, oh, or after short phrases used as interjections, such as "My goodness!" "By Jove!" Exclamation marks should also properly follow short emotional sentences such as "What a tragedy!" "How I love you!" The exclamation mark is also properly used when you apostrophise a person or thing, "My trusty sword!" "You darling!" There is yet another use of this interesting punctuation mark, and one which should be carefully considered. It is sometimes permissible to insert it at the end of a sentence which is not to be taken literally, or which has a surprise element in it. For example, "Mr. Jones is, of course, an extremely important person!" "They arrived at the deserted cottage only to find it inhabited!"

The use of exclamation marks after sentences like these can generally be allowed if the words themselves do not fully and effectively express the meaning and the tone you intend.

When Two Words are One

The Hyphen (-). The hyphen indicates that two or more words are to be regarded as one. You cannot go far wrong in your use of hyphens if you remember that they are used to form one word. All that prevents them being run together without a hyphen, is possibly the clumsiness of the word which would result. The tendency is for hyphenated words or phrases to drop their hyphens when the compound idea has become acceptable and familiar. A flying boat would be a miraculous ship that travelled through the air, a flying-boat is a special kind of flying machine which lands on and takes off from the water. It will probably become "flyingboat."

In your writing, of course, hyphens are used at the end of your line when you have not room to complete the word. You break it off where convenient (and this should be at the end of a syllable), insert a hyphen and put the remainder of the word at the beginning of the next line. (No second hyphen is necessary.)

General Note on Punctuation

Punctuation, commonly called "stops" in writing, has a real purpose in assisting meaning. It is not just a sort of decoration, or a way of enabling you to look clever. So use your punctuation carefully and sparingly. You will notice that throughout your reading and throughout this article, certain words are printed in *italic type*. This is a form of punctuation in order to stress or pick out a word or phrase. You cannot, of course, employ it in your handwriting, nor can you use it on the average typewriter. In writing or typing, therefore, when you wish to *italicise* a word, it is customary to underline it, but be extremely sparing with your underlining.

The Words You Use

Having got over the initial difficulty of English grammar and English spelling so that you compose your writing correctly as a purely mechanical process, you can begin to think of style or character in writing. If all proficient writers were merely masters of grammar and spelling, they would write in practically the same way, yet you know that there are differences in style of writing just as there are different tones of voice in speaking.

Broadly, style arises from two main causes. Firstly, the vocabulary or

words at the disposal of the writer; secondly, the way in which he uses them. This of course is apart from the fact that he will use them grammatically. The average man in a job which does not involve writing, uses at the most two or three thousand different words in his daily speech and in the few letters he writes. The business man will use many more, and the professional writer or journalist will use most of all, perhaps 30,000 or 40,000 different words.

Acquiring a vocabulary in your own language is not a question of solemnly sitting down with a dictionary and memorising long lists of words. If you are learning a foreign language you may have to do this in a modified form; but you acquire your own vocabulary largely by observant reading and listening. To the intelligent person the building up of an extensive vocabulary is a natural process, and by reading most people bring about an improvement of their vocabularies, as well as by experimenting with words and their opposites.

The cross-word puzzles, which appear in nearly every daily paper, are to a very large extent a game of synonyms and antonyms. Crosswords are a first-class game for improving your fund of words.

By far the greatest number of words in the dictionary, however, have no synonyms or antonyms, but express one precise and specific idea. They name one thing. No other word will do. You can best add to your list of such words by observant reading of all kinds.

There are of course many words which are special or technical. It may be that they belong to a particular business, trade, science, or industry. Such words would not normally be required by persons other than those concerned in the particular field. But no word however specialised should be ignored. There may be a time when you would wish to use it, not necessarily to describe the thing to which it applies, but perhaps to make more clear your description of something else. You are now beginning to use what are known as "figures of speech." You are employing a word incorrectly, not so much for its strict definition, as for the clear suggestion it gives.

Synonyms and Antonyms

Hate is a crisp, simple English word with a very definite meaning; it is one which perhaps unfortunately a child learns almost as soon as he learns the word love. Now here are some synonyms of this short word hate. Dislike, detest, abhor, loathe, abominate. You can see that these words cover various degrees of hating, some express more, some less, intensity, and some express it more urgently. Dislike would seem to be the least intense; abominate the strongest. There is in the word abominate a sense that the hate has been carefully considered, endures for a long time, and is strong and unchangeable. If you are learning to be a stylist in your writing you will pick the one word that fits most closely to the sense, so that you make your reader appreciate the feeling as you feel it.

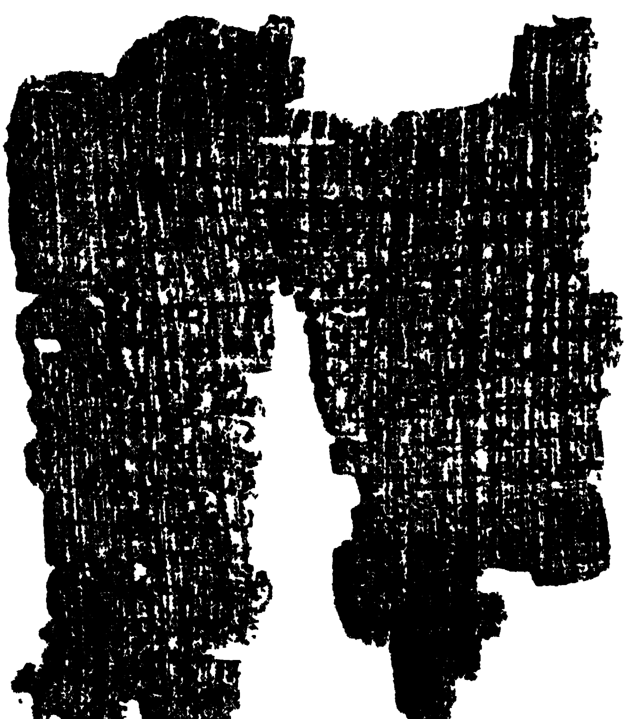
The opposite of a synonym is an antonym, a word which expresses the contrary or negative idea. Good is the antonym of bad. With a wide selection of synonyms and antonyms at your command you will see how easy it is to keep monotony out of your writing, to give it force and balance. Consider the word hate, you may write "I hate people who tell tales." You may use any of the synonyms of hate to improve the sentence and you may also employ the antonyms of hate by turning the sentence around—you can say simply "I do not like people who tell tales."

These are, of course, very easy words and ordinary examples, but you can acquire a wide and varied vocabulary if you are mentally alert both to new words you see in print and to new words you hear in conversation, on the radio,

in the cinema, or at the theatre. Such alertness requires training.

When you hear a new word, or see it, you must not allow yourself to slide over it, merely picking up the general meaning of the sentence. You must allow your mind to focus on the word, study what it looks like, or consider how it sounds. You should then take the first opportunity of finding out its meaning. This you can do either by asking someone who is likely to know, a parent, a teacher, or an older friend, or by looking up the word in the dictionary The last method is perhaps the best, but it requires, naturally, a little more effort. But whatever you do, don't let the chance of acquiring a new word slip by you.

In this way you will gradually have, as it were at your finger tips, a word for each idea you wish to convey, and such is the variety and flexibility of the English language you will have not only a word for each idea, but several words. Your vocabulary will in fact include synonyms which will enable you very often to express more than the mere meaning. With them you can introduce mood, speed, light and shade, and you will select the particular synonym which best fits the general feeling as well as meaning you are striving to convey. Here are some examples of synonyms to illustrate the selectivity of our mother tongue.



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PAPYRUS ON WHICH THE ANCIENTS WROTE

For many centuries papyrus was used by the Egyptians as we now use paper for writing purposes It was made from the pith of the papyrus plant's stems, moistened with water and compressed, often with the aid of gum, to form a sheet Our photograph shows an ancient papyrus which is in process of being restored.

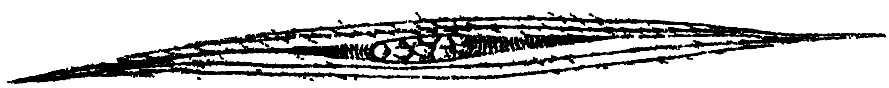
SOME USEFUL SYNONYMS

ABBREVIATE abridge, curtail, condense, compress, epitomise, lessen, reduce, shorten.
ABHOR abominate, detest, hate, loathe.
ABLE capable, competent
ABODE dwelling, habitation, residence.
ABSORB engross, engulf, imbibe, swallow
ABUNDANT ample, copious, plentiful.
ACCEPTABLE agreeable, grateful, welcome
ACCOMPLISH complete, effect, achieve, fulfil, execute, realise, finish.
AGITATE shake, disturb, move.
AID assist, help, succour, relieve
ANGRY passionate, hot, irascible, hasty.
ARDUOUS hard, difficult, laborious.
ARTFUL crafty, artificial, deceitful, cunning, dexterous.

BACKWARD loth, unwilling, reluctant, averse, undeveloped, slow
BECOMING suitable, graceful, decent, meet, fit
BRIGHT clear, shining, sparkling, brilliant, glistening, glittering, lucid, resplendent, clever
BUSINESS– trade, calling, occupation, avocation, profession, employment, work
CALL exclaim, cry, invite, name, summons
CLEVER skilful, able, talented, gifted, ingenious, expert, proficient
CLUMSY awkward, uncouth, bungling, unhandy
COURAGE heroism valour, bravery, firmness, fearlessness, daring
DECLARE– announce, pronounce, testify, proclaim, assert assure, affirm
DIE expire, depart, perish, wither, decay, languish
EAGER– earnest, excited, ardent, impetuous, quick, vehement
EXPLOIT– feat, accomplishment, achievement, deed, performance
FALSEHOOD fabrication, fiction lie, untruth
FAMOUS celebrated, eminent renowned, distinguished illustrious
GENEROUS liberal, bounteous, beneficent, munificent noble kind
GUARD protect, defend shield, watch
HEALTHY well, sound, wholesome salutary, salubrious
HUMBLE meek, lowly, subdued, modest, unpretentious, unassuming
IMPLY mean, signify, denote, involve
JOY—happiness, delight, rapture, ecstasy, pleasure
KEEP—detain, hold, support, retain, maintain, reserve
LANGUAGE tongue, speech, dialect, idiom
LOVE affection fondness, devotion, liking, partiality sympathy infatuation
LUXURY profusion, abundance, excess, extravagance
MAGNIFICENT noble, grand, sublime, glorious, splendid, superb
MYSTERIOUS hidden, dim, dark, obscure, mystic, latent
NAKED exposed, rude, unclothed, uncovered, simple, plain
NAME cognomen, appellation, title, credit, reputation, denomination
NOURISH feed, uphold, maintain, cherish, nurture, support
OBEDIENT submissive, compliant, yielding, dutiful, obsequious, respectful
OFFENSIVE abusive, insulting, impertinent, insolent, rude, obnoxious, mean
OVERWHELM overpower, crush, upturn, subdue, overthrow
PART– share, portion, division, piece, section
PLAY– recreation, amusement, pastime, game, romp, relaxation, entertainment.
PLEASURE– satisfaction, delight, happiness, enjoyment, joy
PUZZLE confound, perplex, mystify, bewilder, entangle
QUIET calm, repose, tranquillity, rest, ease, peace, placidity, stillness
RAVENOUS voracious, rapacious, greedy, hungry
REWARD recompense, remuneration, compensation, satisfaction
ROUGH harsh, uncivil, rude, uncouth, unmannerly, unpolished, rugged, severe
SARCASM satire, irony, ridicule
SECURE safe, certain, confident, sure, procure, warrant
SYMPATHY compassion, condolence, agreement, commiseration
TALK conference, discourse, chat, conversation, sermon, communication, lecture, dialogue
TEACH – instruct, direct, educate, enlighten, coach, expound, lecture, tutor
TRUE honest, candid, sincere, reliable plain upright
ULTIMATE last, final, end, latest
USE practice, custom, habit, service usage advantage, utility
VALUE price, worth, rate, account, regard respect, appreciation
VISIBLE apparent, discernible evident distinct manifest obvious, plain
WARMTH fervour, ardour, cordiality, heat fervency, glow, zeal, animation
WONDERFUL– strange, curious, astonishing, surprising, marvellous, admirable
YET—but, however, notwithstanding, nevertheless, still
ZEALOUS concerned, earnest, ardent, anxious, enthusiastic, warm

There is of course one important factor in this magic art of writing, about which very little has been said in these pages, and that is Grammar You will learn this at school and nowadays it is not made quite such a complicated, dry-as-dust subject as it was only a few years ago. Grammar is today regarded as the servant of the language, not its master

It is something to be learned or understood when one is young so that there is no need to worry too much about it later, because by then its main rules have become almost an instinct. Correct speech and correct writing are less a matter of rules and regulations than of clear thinking, just as good manners depend less on strict rules than the simple instinct of showing consideration for others.



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A MUSCLE CELL

The body is made up of countless millions of tiny specks of living material called "cells." These cells are not all alike; they vary in appearance according to the special work they have to do. Muscle cells are packed closely, like sardines in a tin, and bundles of them are bound together in fibrous sheaths.

HOW THE BODY WORKS

PHYSIOLOGY tells you how your body "works." It would need several large books to tell you *all* about it; and you would need to spend several years using a microscope and doing experiments to help you to understand what was written in the books. Here it is only possible to give you a very simple and general idea.

A Wonderful Machine

The body is sometimes said to be like a machine or a motor car. In some few ways this is quite true; but your body is *much* more wonderful than a machine. A machine can "go," and after a time it wears out; but it cannot grow, it cannot produce young ones like itself, it cannot repair itself while it is still working, and—above all—it cannot *think*. Every living being, therefore, does some things that no sort of machine can be made to do; and many living things can think to some extent. No animal, however, can think so well as an adult human being, or even so well as a small child; so that the human brain is the most wonderful thing in the world.

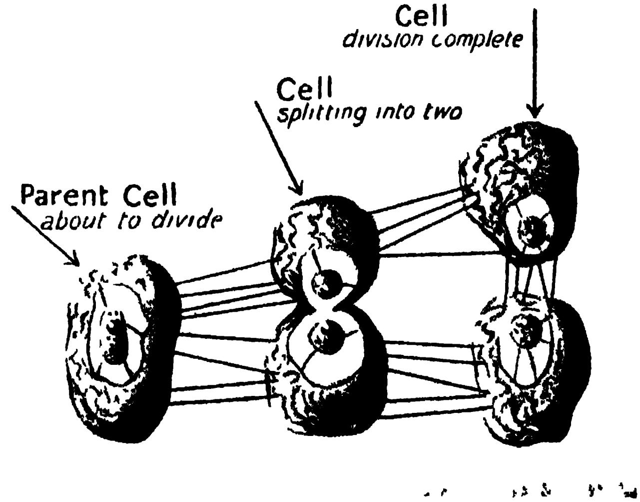
In many ways the body is like a whole nation, consisting of millions of tiny citizens, each working steadily and contentedly at his own special job. Some are members of the government, and some of local committees in charge of certain jobs; some are members of a defence army; some are chemists, some scavengers, some messengers, some transport workers; some are actually little living machines, little living factories and living laboratories; some occasionally rebel, refuse to stick to their jobs, and attack their neighbours. In fact, nearly the whole work of a nation goes on within your body, except farming and fishing and mining; for your body has to "import" its food and other "raw materials"; but here again your body is unlike a machine, for it can decide what it needs, and plan how to supply its needs.

We call the stuff of which our bodies are made "tissue." Thus muscles are made of "muscle tissue," bones of

"bone tissue," and so on. We can recognise the different sorts of tissue under the microscope; for, although they are all composed of cells, the cells of each sort of tissue are different from the cells of other sorts of tissue.

How You Grow

All living stuff—plant and animal—is composed of cells; and cells, or at least some of them, can exist separately as single cells, which absorb food material from their surroundings, keep what is useful to them, and get rid of the rest—together with their own waste material.



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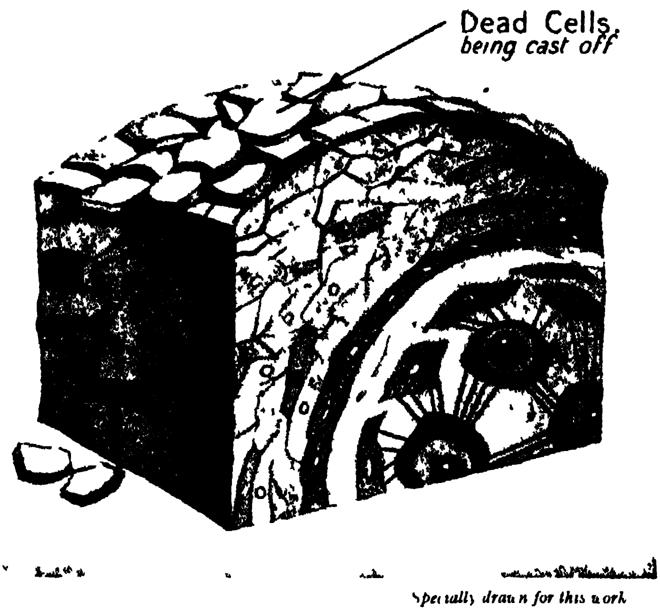
MAKING NEW CELLS

In order to *grow* you must make new tissue so that your body can become taller and heavier. You also need new tissue to *repair* yourself as when your flesh heals after cutting a piece out of your finger. Here you see a parent cell dividing into two daughter cells.

Cells increase by simply dividing into two cells: one cell *becomes* two cells, each exactly like the "parent" cell. *This is how you grow*: your cells divide and divide again, so long as extra tissue is needed—muscle cells divide and increase the number of muscle cells, bone cells divide and make new bone, and so on.



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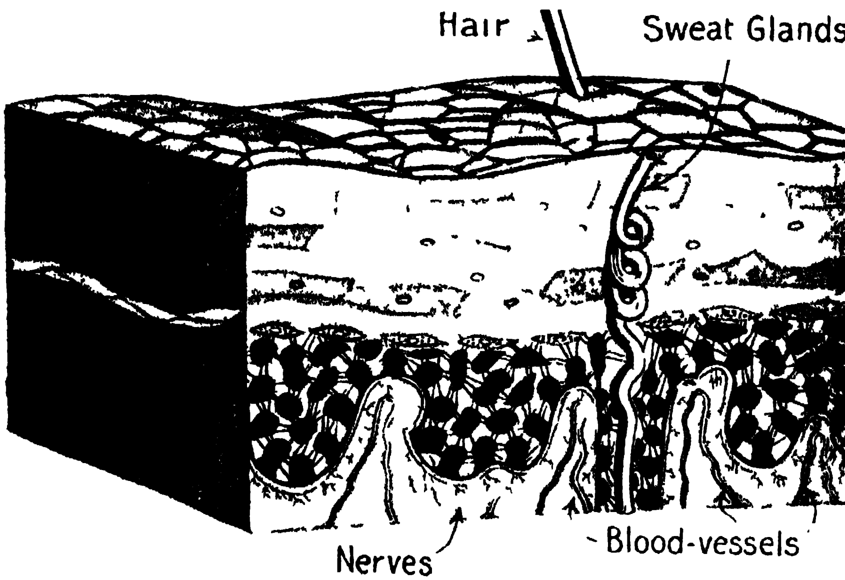
WORN-OUT SKIN CELLS

Your skin wears, just like your shoes or clothes—but you repair it yourself by making new cells to replace those that are worn out. Here you see worn out cells being shed from the surface of the skin.

Cells wear out, so that you have to provide material to make good the "wear and tear" as well as material for growth.

In doing its work a cell uses up fuel, just as a motor engine does. The burning up ("combustion") takes place without flame, of course; but it needs oxygen (one of the gases in the air we breathe) just as much as an ordinary fire does.



WHAT THE SKIN IS MADE OF

The skin contains many different sorts of tissue. The flattened cells on top are called "pavement cells"—they protect the more delicate structures underneath. There are also muscle cells, fat cells, fibre cells, nerves and blood vessels, hairs, and special glands with long coiled tubes (sweat glands) which open at the pores of the skin. The body gets rid of some of its waste matter in the sweat which comes from the millions of sweat glands in the skin.

The materials for growth and repair and the fuel for energy to do work all come from your food, and this food material is carried round the body by the blood; the oxygen for combustion is carried by the blood too; and all the waste materials of wear and tear and of combustion are removed from the tissues by the blood.

The Framework of the Body

Steel and concrete, bricks and wood, provide a satisfactory framework for buildings; but the body needs a very special sort of framework. It must be such that it contains strong "houses" for some of the important organs, such as the brain; it must be flexible—capable of movement, and these movements of many different sorts, so that we can walk, use our arms, bend and twist our bodies, and raise, lower and turn our heads; it must be sufficiently strong to stand a good deal of rough usage; and yet it must not be too heavy; and it must, for many years, be able to *grow* and to grow *gradually*. So that it may fulfil all these requirements it is made of that remarkable substance *bone*.

Bone is nearly twice as strong as oak—a cubic inch of hard bone will support a weight of 2 tons. It is elastic, so that it springs back into shape after some degree of bending; in some parts of the world where suitable wood is scarce, the natives use animals' ribs for their bows. If bone is bent so far that it breaks, it can mend itself by growing fresh bone to join up the broken ends. With all this, bone is light in weight.

The bony framework is made up of over 200 separate bones, wonderfully jointed and held together by strong bands and muscles. There are joints which work very much like the hinges of a door, which can "open and shut"; your finger joints are examples of this

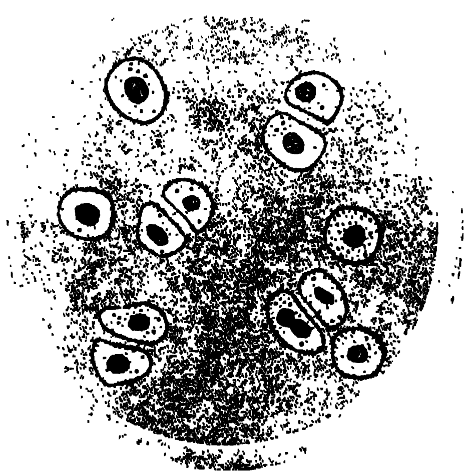
sort. There are "ball-and-socket" joints (smooth rounded knobs fitting into hollows) like those of the shoulders, which allow movement in almost any direction. There are pivot joints, and gliding joints. There is the backbone, which is something like a string of cotton reels separated by layers of india-rubber, and which can bend and twist and yet is sufficiently strong to enable you to drop from a height on to your feet without collapsing into a heap or injuring yourself in any way.

Just as each part of a bridge, designed by an expert engineer, is arranged so as to withstand all the strains and stresses which it will have to bear, so each bone and each joint of your body is so constructed that it can do all that it has to do.

What the Muscles Do

Over all this bony framework are the muscles. A muscle is able to alter its shape, as you realise when you bend your elbow to display your bulging "biceps" muscle. A muscle lies limp and inactive when it is not doing work; but when necessary it can increase its thickness and at the same time lessen its length. If the two ends of a muscle are attached to two bones, then when the muscle shortens itself it pulls the two bones towards one another. A muscle cannot push--it can only shorten itself and pull, and so you will find that muscles and groups of muscles often work in pairs; as an instance one group of muscles pulls and makes your fingers bend, and another group of muscles pulls and brings your fingers out straight again.

When you use a machine, it wears out a little. When you use a muscle, it, too, wears out; but your body very soon makes good the wear, so that the muscle does not become smaller--in fact, the more often you make a muscle work hard, the bigger it becomes. You may have envied the magnificent-looking muscles of a blacksmith or a weight-lifter; but, unless you really need these heavy, bulging muscles for your work, it is certainly not worth while trying to develop them. Most of us need a reasonable amount of strength combined with activity and liveliness, and above all, we need general fitness; so that it is wiser to go in for outdoor games than to exercise with heavy dumb-bells.



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CARTILAGE CELLS

The surface of bones which move against one another in a joint are covered with a smooth, glistening tissue called "cartilage." You can see this tissue on the knobs of the drumstick of a chicken before it is cooked.

Our Waterproof Covering

The whole of the body is protected by a living garment of skin; but the skin is something more than a waterproof covering—it is an organ which has most important work to do.

The skin has fine nerves, which take information to the brain. If you hold your hand too near the fire when you are making toast and are in danger of burning it, the nerves in the skin of your hand flash a message to the brain "We are being burnt!" Your brain at once flashes orders to the necessary muscles, and they snatch your hand away. There are actually separate nerve endings in your skin to receive sensations of heat, cold, and pain, as

well as nerve endings which simply report " touch."

Keeping the Temperature in Order

The temperature of the body must remain nearly constant if we are to be in health. A great deal of *surplus* heat is produced in the tissues of the body, and unless this were got rid of we should soon be in a state of high fever and die of " heat-stroke." The skin has a great deal to do with the regulation of the temperature; it assists to keep the right balance between the amount of heat produced and the amount given off by means of its blood-vessels and its sweat glands. The blood which is circulating in the skin blood-vessels gives up a good deal of its heat to the air on the surface of the skin; and the skin can regulate the amount of blood in these vessels by narrowing or widening them. When moisture evaporates, heat is taken up from the surroundings, which become cooler in consequence.

When we are producing a lot of heat during a game, the skin pours out a great deal of sweat which evaporates; and during this evaporation, much heat is taken up from the skin. At the same time, the blood-vessels of the skin widen, bringing more blood to the surface, and so the rate of cooling is increased.

Yet another very important work of the skin is helping to get rid of some of the waste products from the blood; this waste is dissolved in the sweat. In certain diseases, the kidneys—those great blood filters—are unable to work properly; and we can make the skin do extra work, and get rid of the waste which is usually removed by the kidneys.

Why the Blood " Circulates "

" Circulation " means " going round and round." Blood has to keep on going round and round your body as long as you are alive, whether you are awake or asleep. It does not just wander about aimlessly—it is driven

Specially drawn for this work

THE TWO LAYERS OF THE SKIN

The triangle shows the smooth naked-eye appearance of the skin, but when seen through a microscope it looks like crazy paving, and the surface is uneven. The thick black line in the middle divides the upper skin (epidermis) from the true skin (dermis) which contains the sweat glands, blood vessels and nerves. You can see the capillaries joining the arteries and veins.

round along certain paths, collected up again, sent out to be "cleaned and renovated" (so to speak), collected up again, and then sent out on another journey. The "organ" which keeps the circulation going is the heart.

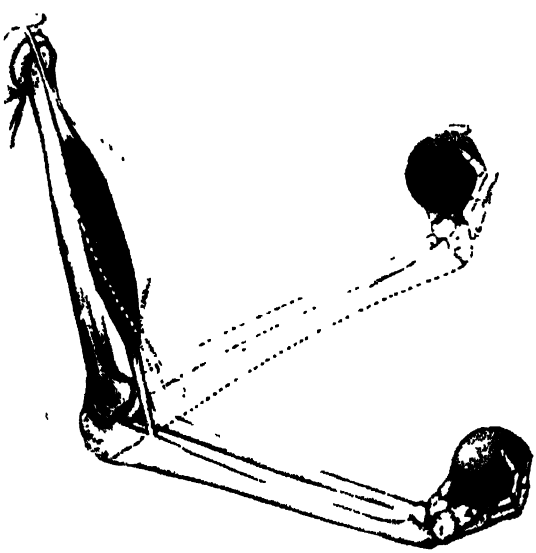
The heart is more than a single pump. It is a very powerful muscular organ, containing two separate receiving chambers and two separate pumping chambers. There are special names for all these chambers, but we need not bother about them here.

For No. 1 pumping chamber the blood is forced out in jerks into a great blood-pipe or "blood-vessel," which divides and subdivides into smaller and smaller pipes, which carry the blood all over the body. These blood-vessels which carry blood *from* the heart are called "arteries." The pipes become so small finally that they are called "capillaries" or hair-like blood-vessels; they form a complete network in every part of the body, but they can only be seen by means of a microscope.

The blood from the capillaries moves on, and the capillaries join up into larger and larger blood-vessels which at last return the blood to No. 1 receiving chamber of the heart. The pipes which carry blood *to* the heart are called "veins."

From No. 1 receiving chamber the blood is forced into No. 2 pumping chamber, and from there it is pumped into the lungs through an artery, which divides and then subdivides into capillaries; and these form a network throughout the lungs. The blood collects up again into veins, and finally into one vein, which takes it back to No. 2 receiving chamber of the heart. From No. 2 receiving chamber the blood is forced into No. 1 pumping chamber, and then the whole business is repeated.

You will notice that there are already *two* circulations one from the heart, round the body, and back to the heart, and the other from the heart, to the lungs, and back to the heart. There is yet a third circulation, which will be mentioned later.



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HOW A MUSCLE MAKES YOU MOVE

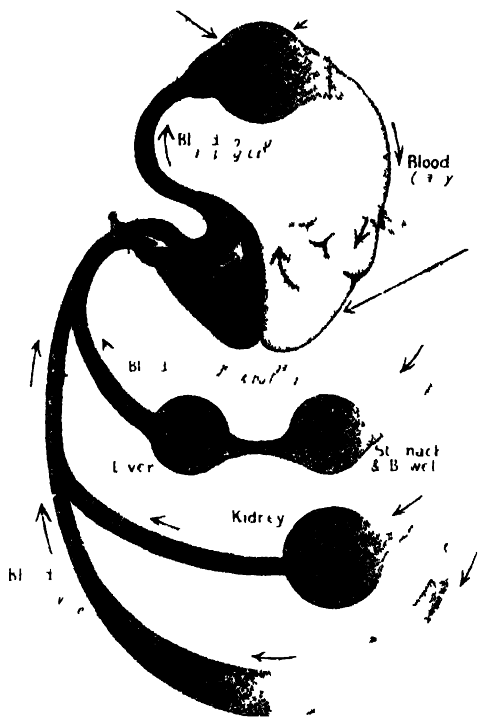
When you contract your biceps, it pulls in its attachments. As it cannot pull your shoulder down towards your elbow, the resulting movement takes place at the other attached end of the muscle, and your forearm is raised

Why Blood is Red

The blood does so many things, and so much happens to it, that it is really difficult to know where to begin. If it were just plain red stuff like paint, and we could imagine that we were watching a single drop of it for half an hour or so, it would be quite easy; but it is not just plain red stuff, and the parts of even a tiny drop probably do not remain the same for any length of time. Blood consists of a clear fluid containing fuel material, repair material, waste

material and many other things; and floating along in this fluid are millions of tiny white cells, and many more millions of tiny disc-like red cells which give it its colour, and all the time the blood is doing things—giving up some of itself and receiving stuff into itself.

Perhaps we could follow one red cell for a while. It was made in some part of the bone marrow, but we will begin following it from one of its visits to the No. 1 pumping chamber of the heart. With many millions of other red cells it is pumped out into a huge artery, and tumbled along jerkily into ever-narrowing blood-vessels until at last it is moving in a capillary which winds its way among the cells of a muscle which is being used. The capillary is so small that there is only just room for one red cell to pass along it at a time, and even then it is a close fit, so that the red cell touches the walls of the capillary. Each muscle cell is like a tiny motor engine, and it needs oxygen to enable it to burn up fuel material to provide it with the energy or power to work. Now the red cell is carrying oxygen—not in bubbles, but dissolved, so to speak; and it is able to give up this oxygen, which oozes through the walls of the capillary and is used by the muscle cell.



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THE CIRCULATION OF THE BLOOD

The blood makes two journeys: one to the lungs to collect oxygen and get rid of carbon dioxide, and the other throughout all the body tissues and organs to deliver food and oxygen and collect up carbon dioxide and other wastes, like the milkman who delivers milk and at the same time collects up the empty bottles.

The muscle cell, like the motor engine, gives off "exhaust gas," which oozes through the walls of the capillary and is taken up by the red cell. Our red cell—no longer such a bright red as it was when it was carrying oxygen—is pushed along and passes into a tiny vein which in turn passes it into a larger vein, until at last it is tipped back into No. 1 receiving chamber of the heart. From the heart it will be sent off to the lungs; what happens to it there will be told later on. Here we will just say that when it returns from the lungs to the heart it will again be of a nice bright red colour, and all ready to be sent off to some part of the body to carry out some other task.

Lymph and What it Does

Now let us follow a tiny drop of the

clear fluid in which this red cell was floating. It, too, reaches the capillary close to the muscle cell where the red cell carried out its task. Some of it oozes through the capillary wall, and round the muscle cell. The muscle cell needs some of the fuel material, just as the motor engine needs petrol; this fuel it absorbs from the clear fluid, together with a little repair material. The rest of the clear fluid moves on and is picked up into tiny tubes, which are very similar to the capillaries; and these tiny tubes join up into bigger and bigger tubes and finally into one large tube; and this empties the clear fluid back into a vein which is just taking blood back into the heart. This is the third "circulation" we mentioned. The clear fluid (which is called "lymph") goes out from the heart with the blood as far as the capillaries, but it then travels along a whole lot of tubes which are not used by the blood. It joins the blood again just before it reaches the heart.

The White Soldier Cells

The journey of a white cell may be more exciting than that of a red cell; for this white cell may have to act as a soldier, and defend the body from dangerous invaders. When a thorn sticks into your fingers there may be harmful cells or germs on the thorn, or on your skin, or in the air, and these may enter through the hole in your skin. Now the white cell can change its shape; when it meets a hostile cell it tries to flow all round it and then consume it. If there are sufficient white cells on the spot to destroy all the invading germs, well and good, but sometimes the enemies are strong and numerous, and many white cells are killed by them. Your body, however, hurries along more and more white cells to the spot, until at last they gain the victory.

You will have noticed that sometimes when you have pricked your finger it becomes hot and red and "inflamed"; this is because of the increase in the amount of blood sent to the danger spot. You may also have noticed some yellowish "matter"; this consists of dead white cells which have been slain in doing their duty.

These three are simply examples of the many tasks which the blood has to perform. A complete list of them would take quite a time, but here is a short and incomplete list:

Some Tasks our Blood Performs

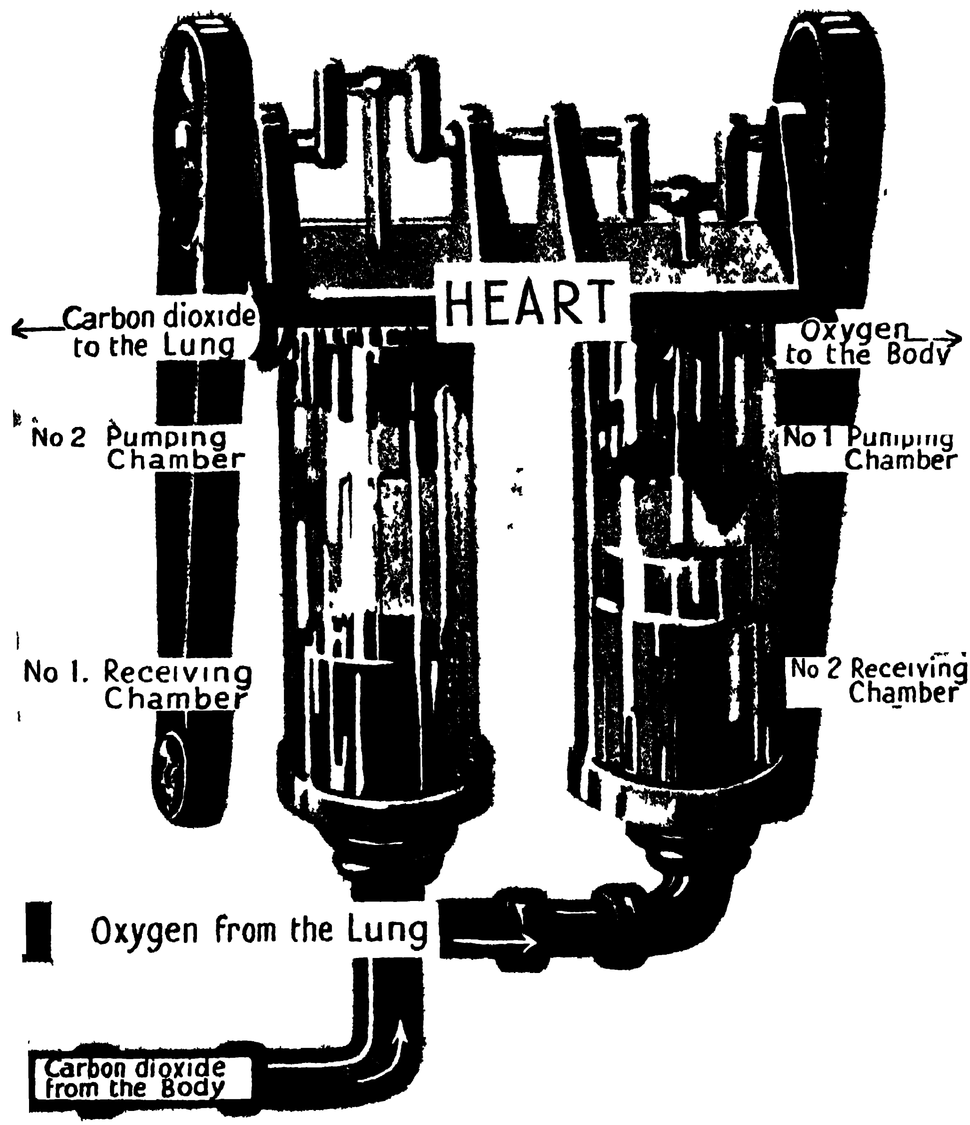
The blood has to collect up into itself the digested food from the digestive organs, and the red and white cells from the parts where they are made, and oxygen from the lungs, and it has to carry away waste materials from the tissues. It has to supply all the organs and glands, which act as little chemical factories and laboratories, with the material from which they make their special juices, and it has to take some of these juices round to the parts where they are needed.

It carries various protective substances ("anti-toxins," etc.) which are able to destroy the poisons with which harmful germs may be attacking us. It visits various cleansing and filtering organs, where it parts with harmful waste matter, and also with any substance of which there is too much, for the health of the body requires that only a certain amount of some substances should be present in the blood, and if there is too much the body suffers. It carries sugar and starch to be stored up in the liver and muscles, so that there is a supply ready for use when it is needed; and when necessary, it fetches these reserves and delivers them to the places where the body needs to use them.

It visits the heart frequently, and there it is all mixed up together, so that its contents remain very much the same all over the body.

Many of these things are going on all the time and some of them only sometimes; and, of course, the body

WHAT THE HEART DOES



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If there were no means of keeping the blood circulating along its proper channels we should soon die for want of food and oxygen and from poisoning from our waste products. The heart is a powerful muscular organ which is specialised to form a central pumping station. One pump keeps the blood circulating through the lungs and the other pump maintains the circulation through the body. The heart never ceases work during life but it has much less work to do when you are sleeping than when you are taking vigorous muscular exercise.

can speed up things according to its needs. When you have just eaten a meal, for instance, there is a great bustle to supply digestive juices, and to supply fuel material for the organs which have to manufacture the juices and for the organs which have to churn up the digesting food. When you are running, much fuel has to be used up, so that a great deal of oxygen is needed; you must breathe quickly and deeply, and your heart must hurry up the circulation to the lungs. When you are asleep, on the other hand, both your breathing and your heart-beats slow down very much.

It is almost impossible to compare the blood with anything else in the world. In some ways it is like the water of a whole network of inland rivers and canals and streams, flowing past or through factories, carrying large loads of all sorts of things to these factories and taking away their waste; carrying messengers and troops and workmen; in fact, making possible the whole business of carrying on life; but even this does not give anything like a complete picture of *all* that the blood does.

Why You Breathe

Respiration is the breathing in of air into our chests and the breathing of it out again.

The air is composed almost entirely of two gases. About one-fifth is oxygen, which is a very *live* sort of gas; of course, a gas cannot itself be alive, but oxygen strikes us as being a very active sort of gas because of what it does. If you plunge a glowing splinter of wood into a jar of oxygen it at once kindles into a flame and burns brightly; if you plunge a thin, red-hot iron wire into oxygen it sparkles, splutters and burns like a firework. It is this gas which your tiny muscle cells must have so that they can burn up fuel material to make energy or power-to-work. Most of the other part of the air is a dead sort of gas which just thins out or dilutes the oxygen; for if we took too much oxygen, everything in the body would go on much too rapidly, and we should wear out too soon.

When fuel material of any sort burns, it combines or joins up with the oxygen; and the fuel and the oxygen together become another sort of gas, which is called "carbon dioxide"; (this is sometimes written CO_2 for short). It is this gas which we compared to the exhaust gas of a motor engine, when we were talking about the working of the tiny muscle cell. You will remember that the red cell gave up oxygen to the muscle cell and took away the "exhaust gas," which we can now call carbon dioxide.

How the Red Cells Work

We must now see how the red cell gets rid of the carbon dioxide and takes in a fresh supply of oxygen; for this is the whole aim and object of respiration, and the exchange must be carried on continuously or you will cease to live.

When you "breathe in," you take in air through your nose. You *can* breathe through your mouth; but this is unwise, because in your nose the air is warmed and moistened and the germs and dust are trapped. The air passes into a great pipe, which divides into two pipes, one of which goes to the right lung and the other to the left lung. These pipes divide up into smaller and smaller pipes, very much as the blood-vessels do; but, instead of becoming capillaries finally they end in tiny air-sacs.

The lungs are sometimes said to be like sponges; but they are much more like thick bushes with very tiny leaves, with pipes instead of stems, and air-sacs instead of leaves. If all these air-sacs could be spread out quite flat they would cover the floor of a small hall about 10 yards long and 10 yards wide; as they are all packed inside your chest it is plain that the walls of the air-sacs are extremely thin.

You will remember that the heart

pumps the blood into the lungs when it returns from a journey to some part of the body, carrying within its red cells the carbon dioxide. The arteries which carry this blood to the lungs split up into smaller and smaller blood-vessels until they become capillaries, and these capillaries run round all the little air sacs. The red cells give up their carbon dioxide, which oozes through the walls of the capillaries and through the walls of the air-sacs; at the same time the oxygen from the air-sacs oozes through into the red cells. The red cells, having exchanged their carbon dioxide for fresh oxygen, are gathered up again into blood-vessels and taken back to the heart, all ready to be sent off to some part of the body again.

Preparing the Air

When you "breathe out," the carbon dioxide passes out through your nose. The dead sort of gas we mentioned is just breathed in and breathed out again; it does nothing and nothing happens to it except that it becomes warmed. There is a good deal of moisture in the air you breathe out. If you think for a moment, you will find that nearly all living stuff is moist; moisture seems to be necessary to life, or at least to active life, and so the whole of the cells which compose your body are always moist. The air brings a lot of moisture with it when it comes away from the millions of tiny air-sacs.

You see that the organs which keep you supplied with oxygen and get rid of your "exhaust gas" are the *heart*—which sends the blood to the lungs and then receives it back again, and the *lungs* there the actual exchange of gases takes place; but we must not forget the *nose*, which has important work to do in preparing the air to be taken into the lungs.

Quite probably you think that you "blow out your chest" by forcing air into it until it is full and hard; but this is not so. The muscles of your chest move the ribs and make the chest bigger round, while a great flat muscle which forms the base of the chest lowers itself and so makes the chest bigger from below. The lungs fit closely to the insides of the chest, although they are not actually attached; and so, when the chest becomes bigger, the lungs are sucked out, so to speak; and it is this that makes them suck air into the air-sacs. You *can* breathe without moving your ribs; but then you are only using the big flat muscle at the base of the chest, and you have to lower this and so push out your stomach.

The muscular movements by means of which you breathe must go on all the time you are alive; and as they work while you are asleep, they must be able to work without your "willing" them to work. You will read later on that quite a lot of the work of the body goes on without your having to "will" it; but the breathing muscles are interesting in that you can control them if you wish to do so; while if you take no interest in them they go on working just as well.

How the Body deals with its Food

The material from which a machine is made and with which it is repaired has to be specially prepared before it can be used; and sometimes its fuel also is a manufactured article. Your body, the wonderful human machine, extracts and prepares its own fuel and building materials provided that we supply the "raw material" in the form of suitable food. Just as a builder needs special material in order to build a house, so our bodies need food which will supply the living bricks and mortar and tiles and window-glass and wooden beams for building up the living house which we occupy, and for repairing it when parts get broken or worn out, and for enlarging it as we grow.

The baby doubles its weight during the first six months of life, and by the end of the first year it should weigh three times as much as when it was born: afterwards, the rate of growth

slows down considerably until, when we are adults, the only parts that continue to grow are the hair and nails. The baby, then, needs a good supply of the building foods; and these, together with its fuel food, it obtains from milk. You probably know that milk is a splendid body-building food for boys and girls and grown-ups as well as for babies; but people with teeth need solid foods, too, and they can extract the building materials from such foods as meat, fish, eggs, cheese, peas, beans and lentils. Then we need also "fuel foods" to supply heat energy and work energy, and these we get from the starches and sugars (carbohydrates) and fats.

I want you to realise that the food we eat is of no use to nourish the body until it has been digested and absorbed into the blood. You could actually starve to death in spite of large meals of unsuitable food—or even of suitable food if your digestion were unable to deal with it.

Let us see what will happen to the next dinner we eat. In order to make it quite clear to you, the pictures show the work being done by different kinds of machinery in charge of workmen; but you realise, of course, that your body machinery looks altogether different and that your "workmen" are cells and groups of cells.

Why We Chew our Food

In the mouth, your front teeth are the "cutters" which slice off portions of food. This food is then passed along by your tongue and cheek muscles to be crushed up by your back teeth, the "grinders"; and while you are chewing your food, it is being mixed with a digestive juice, the saliva or "spit," which acts on some of the starchy food; so you see digestion really begins in the mouth.

When the food has been chewed to a pulp and thoroughly mixed with saliva, it is ready for the next stage of digestion, which takes place in the stomach. The tongue pushes the food to the back of the throat and it is swallowed. Now the food has to make its way down the food pipe which passes through the neck and chest to the stomach. Certain muscles in the throat and a cleverly arranged little flap prevent the food from going the wrong way from the mouth when we swallow; otherwise, some of the food might pass into the air-pipe leading to the lungs. When, as occasionally happens, a crumb does accidentally get into the air-pipe, we make vigorous efforts to send it back again into the mouth by coughing.

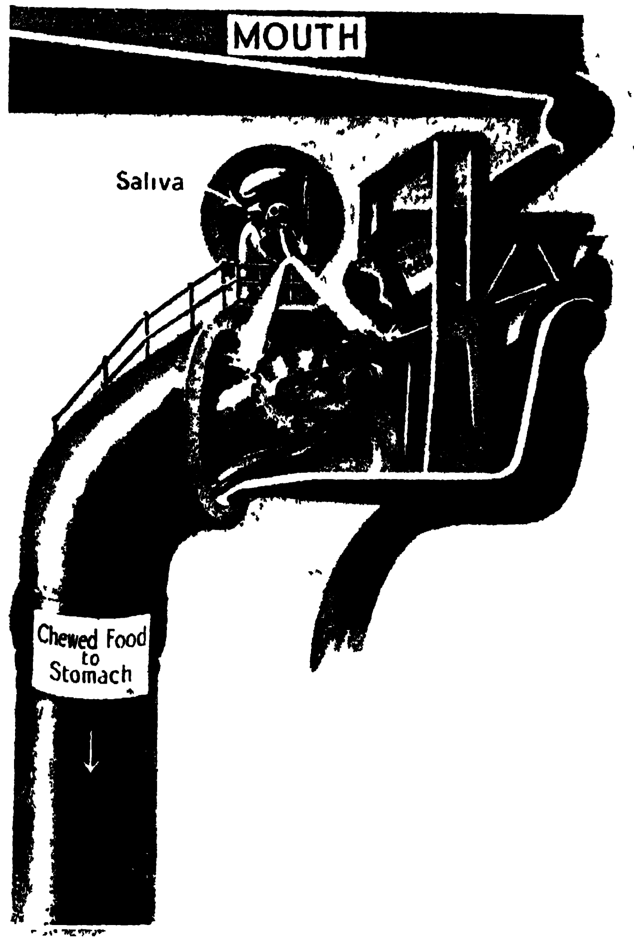
What Happens to the Things We Eat

Now the food which has passed from your mouth does not just drop down into the stomach; as you know, you can swallow when you are lying down. It is pushed along by the muscular walls of the food tube, which widens out in front of the lump of food, so that it can pass along easily, and contracts itself immediately behind the food You can imitate this by pushing an orange into a stocking and then squeezing the stocking behind it.

Your dinner will thus be collected into the stomach, which is really a part of your digestive tube enlarged so as to form a bag, with an upper opening leading to the food tube and a lower one leading to the small bowel. The lower door remains firmly closed while the meal is being well churned and mixed with other digestive juices which together are called "the gastric juice," and act on the body-building foods ("proteins").

When the stomach part of digestion is finished, the door opening into the bowel tube allows the contents to pass through, and bowel digestion begins. Our picture shows a little man controlling this doorway. In the small bowel, more digestive juices are poured on food, some from the liver and some from the pancreas, and some from the lining of the tube itself. When we use the pancreas of an animal for food we call it sweetbread.

Here, in the bowel, digestion is completed; the food is quite dissolved, and you could no longer recognise portions of meat and cabbage and potato and pudding. The starches and sugars (bread, potatoes, jam, syrup, etc.) are changed into a special form of sugar; the fats (fat meat, suet, butter, cream, etc.) are changed into a kind of soap (the "soap" is changed back into fat as soon as it has passed through the bowel); and the building materials (meat, fish, egg white, etc.) are prepared into an acid substance. Now the food is ready for use, and it passes into the circulation. The remainder of the food we have eaten, which is not required for nourishment, is got rid of through the large bowel.



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DIGESTION BEGINS IN THE MOUTH

The front teeth are represented by the knife which is slicing off a portion of food. The food is then mixed with a digestive juice (saliva) and passed through the grinding rollers (back teeth). Thus food in the mouth is broken up, softened and moistened and partially digested during mastication. The saliva changes some of the starchy foods, such as bread, cereals and potatoes, into a form of sugar.

Why the Liver is Important

It is most important that the body should never be short of fuel, and so we are able to store sugar in the liver, to be released into the blood as we need it; some sugar is stored in the muscles also. The sugar is stored in the form of a special kind of starch, and it is changed back again into sugar before it is actually used. In the picture of the liver you will see the sugar being brought along from the bowel in the blood-pipe; and on the right of the picture you will see some of it taken out of store again and sent off to be used. We are also able to store fat in various parts of the body.

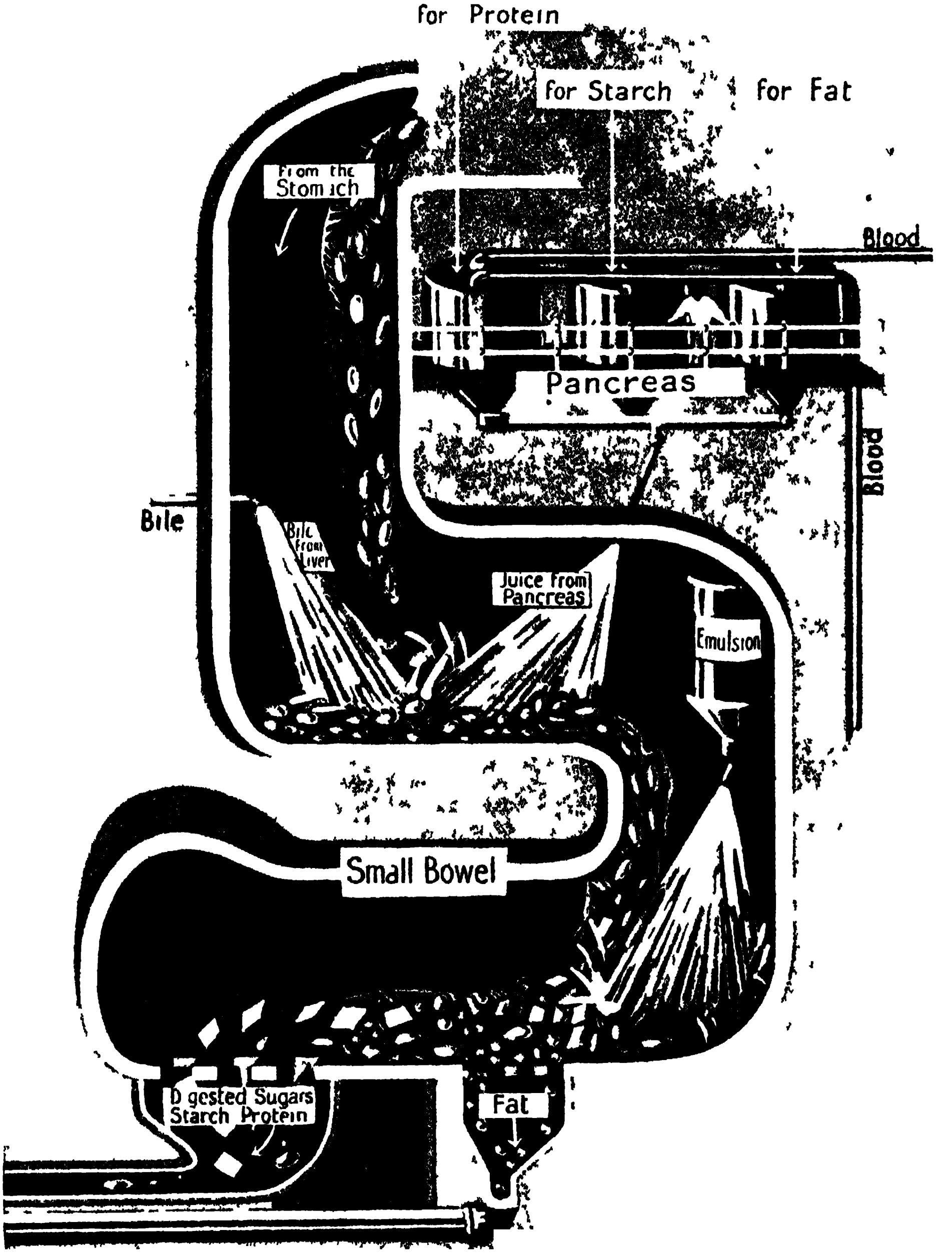
Other things happen in the liver, besides this storage of sugar. Worn-out red blood cells are extracted from the blood and pass out of the liver in the bile. Any excess of building material is filtered out of the blood, and changed into a form in which it can be got rid of through the kidneys. Certain poisons

WHAT HAPPENS IN THE STOMACH

Specially drawn for this work.

You see food arriving from the food pipe into the stomach ; and there it will remain until stomach digestion is completed. By movements of the muscular stomach wall, the food is thoroughly mixed with the gastric digestive juices, which include an acid (HCl), pepsin and other ferments. (1) Living germs swallowed with the food are killed by the acid. (2) Digestion of protein (body-building and repairing food) begins. (3) The outer coats of the fat cells are dissolved, setting free the fat. (4) Milk is curdled. The stomach should have emptied in three to four hours after an ordinary mixed meal.

DIGESTION COMPLETED IN THE SMALL BOWEL



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On leaving the stomach the food enters the small bowel where bile from the liver makes fats more easily dealt with; the juice of the pancreas acts on all kinds of foods and the juice from glands in the wall of the bowel completes digestion. While this is happening, the food is being churned up and pushed along towards the large bowel, and about five hours after a meal the undigested waste of the food begins to enter the large bowel. The digested food is taken into the circulating blood and is then carried to the liver for a thorough sorting out.

(which we call "toxins") are also removed from the blood as it passes through the liver, and are excreted, through the bile flow, into the bowel. The liver, then, has a great deal of important work to do; and you will understand why we feel "out of sorts" when the liver is not working well.

The blood passes on from the liver to the heart with its food supply (fuel and building material) ready to be used by the body cells; but the fuel part of it would be useless without oxygen, so the blood is pumped from the heart to the lungs, where the red cells may get a supply of oxygen from the air we have breathed in. Now everything is ready for the body to make use of the food, and the blood is taken back from the lungs to the heart to be pumped round, carrying its precious cargoes to all the parts of the body. When it reaches the tiny capillary blood-pipes, the red cells give up their oxygen and the fluid part of the blood oozes out to bathe the body cells. Thus the fuel and oxygen to supply heat and energy, and the building material to repair wear and tear, and material for growth, are finally delivered where they are needed.

All About Vitamins

We have talked of the fuel-foods and the building-material foods; but these alone are not sufficient to keep us alive. We need minute quantities of substances called vitamins. You can think of some of these as the lubricating oil necessary for the body machinery; without them the machinery would cease to work, no matter how much fuel-food was provided. Others are necessary to enable the body to use the building-material for growth.

Some vitamins are found in certain fatty foods, others in watery foods; the first kind we call "fat-soluble" vitamins, and the second "water-soluble" vitamins. The vitamin which prevents the disease rickets ("fat-soluble D") is found in most animal fats, and especially in cod and other fish liver oils, liver, fish roe, egg yolk (which contains a large proportion of fat) and in the butter and cream from the milk of pasture-fed cows. This vitamin is sometimes called "the sunshine vitamin," because it can be produced in the body by the action of sunlight on the skin. We can store this vitamin in our bodies; so that one advantage of sun-bathing during the summer is that we obtain a supply of vitamin D to help us over the winter.

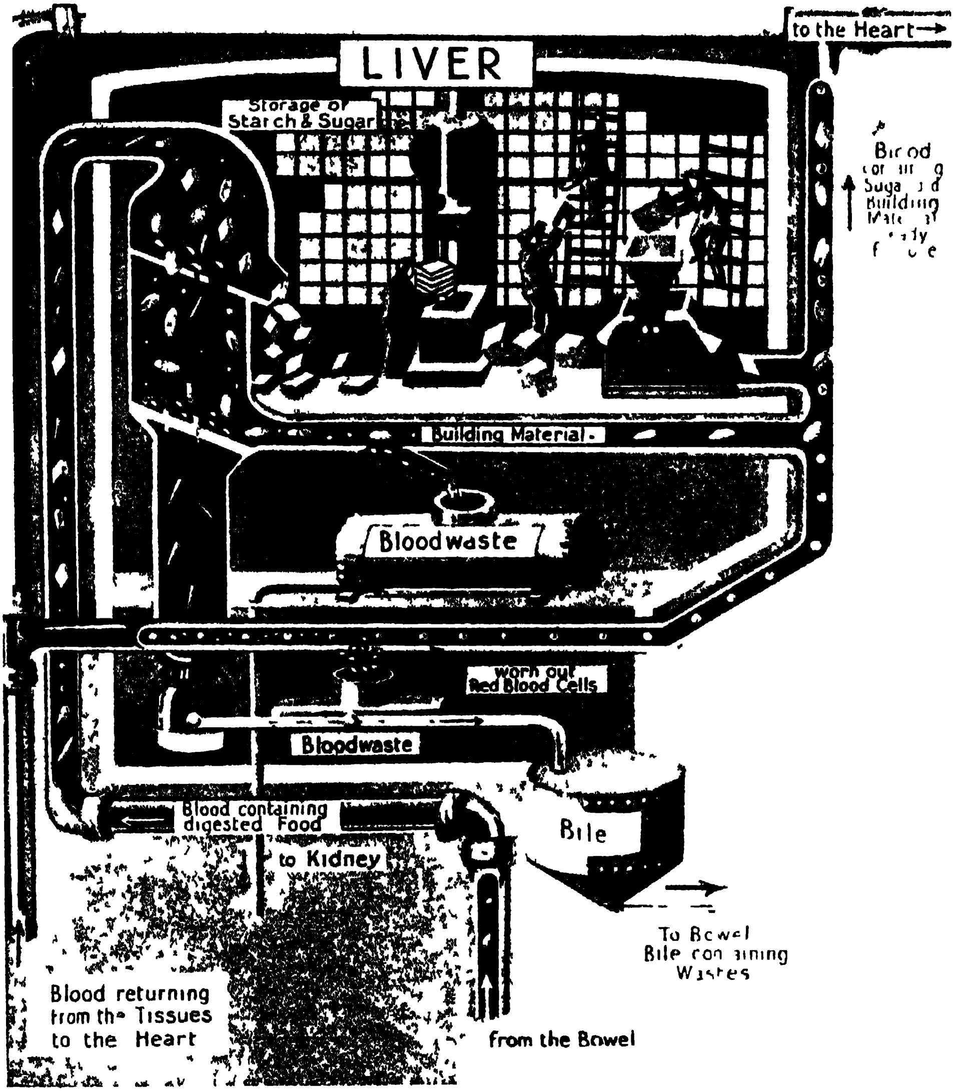
Defence against Germs

The other fat-soluble vitamin is named "A"; it assists us in defending our bodies against infection with germs. If our food contains sufficient of this vitamin, we are less likely to develop diseases and better able to conquer them than if there is a shortage. Vitamin A is found in the fat foods which contain vitamin D, and also in green vegetables, carrots and tomatoes.

The water-soluble vitamins include vitamin B, which is necessary for the proper nutrition of the nerves and muscles. Lack of this vitamin causes the disease beri-beri, which is quite common in the East. Vitamin B is found in the seeds of plants, and in the eggs and internal organs of animals. Foods particularly rich in this vitamin are yeast, bran, peanuts, dried peas, beans and lentils, nuts, liver, heart and kidney, and whole-grain cereals, such as wholemeal flour and wholemeal bread.

Vitamin C is another water-soluble vitamin, and lack of this causes the disease scurvy, a disease which used to cause the deaths of a great many sailors in the Navy, before we discovered the cause and the cure. It is found in fresh fruits and vegetables.

On a good mixed diet, including milk and dairy produce, eggs, salads, oranges, tomatoes, nuts and whole-grain cereal foods (such as wholemeal bread, unpolished rice and whole barley), we are in no danger of suffering from shortage of vitamins. If, however, we eat mostly "refined" foods from which vitamins



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THE WORK OF THE LIVER

The liver is a large gland which acts as a sort of clearing house and store house where the digested food and any other material brought from the bowel is thoroughly sorted and dealt with. Some is passed on into the blood to supply the body with nourishment; some is stored, to be given out again as required; whilst some is rejected as poisonous and sent out to be got rid of by the kidneys or in the bile. In addition the liver filters off the worn out red blood cells which also pass out in the bile.

and minerals have been removed in the manufacturing processes, then the body machine will certainly be injured and we shall suffer from ill-health.

In order to maintain normal health and growth, we must eat food from which the body can get all that it needs—fuel, building material, minerals, vitamins and water. We cannot get all the water we need from food, although some foods contain up to 90 per cent. of water; we must drink water, too

Now you can understand what is meant by a "balanced diet." There is no doubt that a great many of the common ailments are caused by not eating the right kind of food.

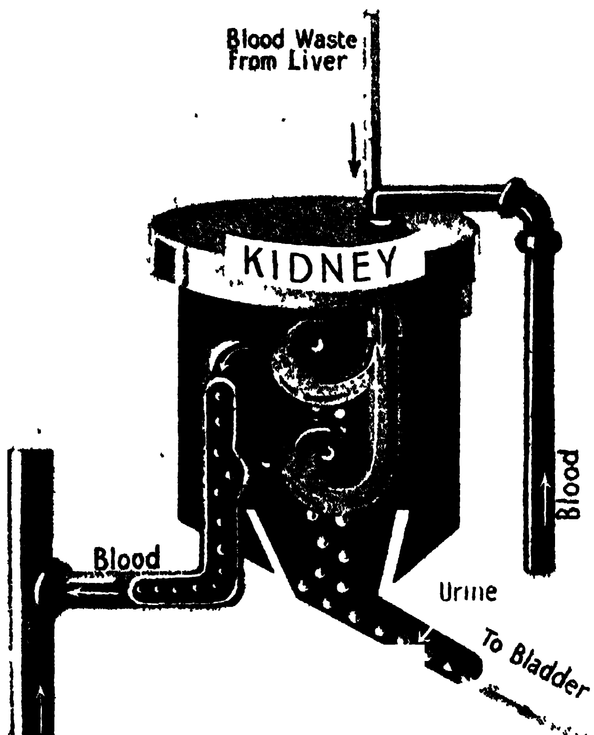
Removal of Waste

The body, like all living matter, produces waste; and if the waste matter is not got rid of regularly, poisons will accumulate in the blood. Our bodies have their own "health service" for getting rid of wastes, and the organs which are responsible for this function are called "excretory organs."

The living substance of which the body cells are composed (protoplasm) is in a continual state of activity, building up and breaking down. The waste products from this "wear and tear" are passed into the blood, which in due course flows through the excretory organs—the kidneys, lungs, skin and bowel wall. From the burning up of the fuel foods to produce heat-energy and work-energy, the waste gas, carbon dioxide, is formed, and this, too, finds its way into the blood, to be carried off and excreted through the lungs in the air we breathe out.

If you look at the picture of the liver, you will see that certain wastes are filtered off from the blood and drained into the bile, to be got rid of when the bile flows into the small bowel. The kidneys (there are two) are special filters, composed of masses of tiny tubes and specialised cells. They cleanse the blood which flows through them, and the waste products are excreted in the urine.

The waste matter which leaves the body through the bowel includes the undigested food, secretions from the bowel wall, large numbers of germs (mostly dead ones) and cells shed from the inner surface of the bowel.



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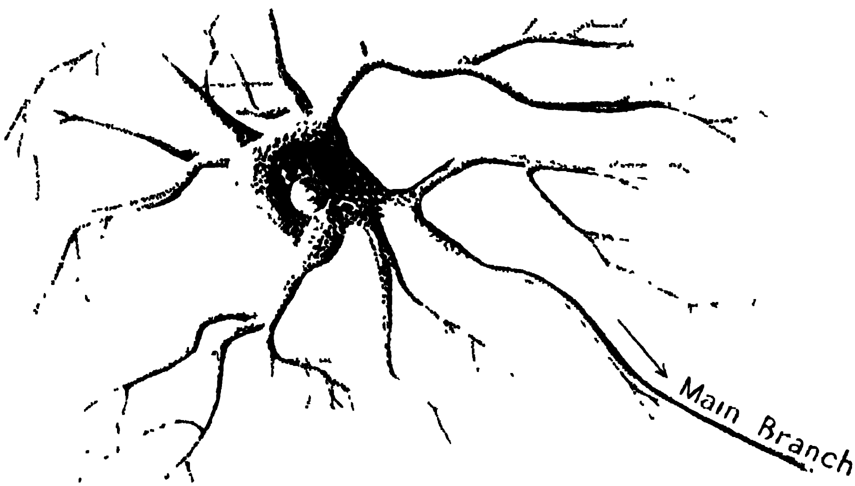
THE KIDNEY

The kidney is a living filter. The tiny balls passing down to the bladder represent the waste material, the other balls passing along the blood-pipe which leaves the kidneys are materials the body needs. The kidney is able to sort out the things carried by the blood, rejecting what is harmful, and retaining what is useful. Actually, the kidney is packed with thousands of tiny coiled tubes.

YOUR NERVOUS SYSTEM



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A NERVE CELL

These are the cells which are found in your brain and spinal cord. You see how different they are from muscle or cartilage cells. The long main branches of nerve cells are bound together in bundles to form nerves. By means of these nerve cells and their branches the brain and spinal cord, which form a sort of central government, are kept in touch with what is happening to the rest of your body.

YOU will by now agree that the body is in many ways like a great nation, with millions and millions of citizen cells, each one carrying on its work for the good of the whole, whether it is working as a single cell (like a red blood cell) or as one of a group (like a muscle cell or a gland cell). A nation needs some form of government, and such a well-run nation as your body needs a very efficient government indeed.

How your Body is Controlled

The work of governing is done by cells—*nerve* cells. These nerve cells vary a good deal in size and shape, but you can form a fair mental picture of one if you imagine a tiny white or grey cell, with no very regular sort of shape, and having many branching fibres and one long fibre; the long fibre may be very long, and bundles of fibres lying alongside one another are called "nerves." The whole of your bodily outfit of nerves and nerve cells together is your "nervous system"; and the great gathering of nerve cells in your skull, together with its continuation down inside your spine, is called the "central nervous system."

You may regard the central nervous system as being the government, with the brain as the thinking, knowing, remembering, considering, deciding and willing departments; while the spinal cord may be compared to county councils or some such subordinate controlling bodies. The great network of nerves and nerve cells throughout your body gathers information *from* every part, and takes instructions *to* every part.

You will readily understand that a

central government should not be troubled too much about routine affairs —jobs that have to be done in very much the same way, day after day. It is much better for some subordinate council or department or officials to look after such things; and so you find, in your body, that such things as breathing, digestion and the circulation, and other matters, are controlled and regulated without your having to "give your mind" to them.

It is, roughly, true to say that the whole of the actual "running" of the body, the *internal* affairs of the nation, so to speak, are carried out in this way. Your mind does not concern itself with them unless things are going wrong, and in some cases your mind cannot interfere with them, at least, to any great extent. Nevertheless, everything is conducted in a perfectly orderly and controlled manner—by means of nerves and nerve cells and groups of nerve cells; the needs of the body are noticed and reported, and the necessary instructions are given without your *knowing* anything about it.

Why Exercise makes us Breathe more Quickly

If you are exercising much, there is increased combustion in the muscle cells, and, because of this, a tendency for the carbon dioxide in the blood to increase; the increase in carbon dioxide causes the breathing control to send instructions to the breathing muscles to work extra hard; in consequence of this you breathe more quickly and more deeply, and the extra carbon dioxide is the more rapidly exchanged for fresh supplies of oxygen; and of course your heart has to work harder and faster too. All that you *know* about this is that you breathe faster, and that your heart beats more rapidly. The same hurrying-up of the breathing will take place when you are very high in the mountains where the air is rarefied and you are not getting as much oxygen as you want.

Many actions you have to think about at first—walking downstairs, guiding a pencil, playing on the piano; and some of them are so difficult that you have to give your whole mind to them. Yet, after a time and "with practice," as we say, these things become almost as easy and automatic as breathing. It is as though the mind had been able to say to some other part of the nervous system: "There you are! That's the way to do that. Just you carry on and see that it is done in the same way whenever I want it done—and don't bother me about it."

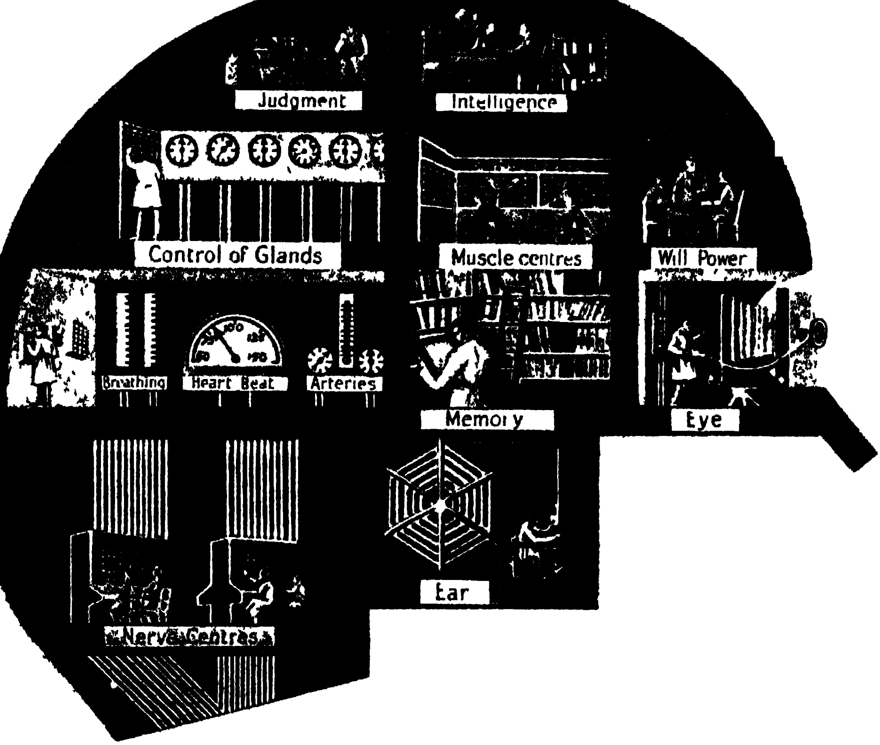
Why We Sneeze

We have not yet finished with the things that are done without your having to "give your mind" to them. If you happen to sniff pepper you will sneeze. Exactly what has happened? The nerve cells whose job it is to report have sent back a message, "Something here is upsetting us!" The message goes to some local control centre, and from this instructions are sent out to all the muscles which have to act to make a sneeze "Get busy, and blow that stuff out of the nose—Sharp!" You don't have to *think* about this—in fact most people can't sneeze to order; you can, however, stop a sneeze sometimes, which shows that your mind *can* exercise some control.

Again, if someone puts a drawing pin on your chair you don't wait to think about it. Your whole body leaps up —*before you know what it is all about.* Perhaps we had better not imagine the messages which might be sent in this case. This leap of your whole body, because something has hurt some part of it, shows you how well the communications of the whole body are arranged; it is almost as though every part is always on the telephone to every other part, but only gives attention where and when there is need.

These actions in which some cause or "stimulus" leads to some effect or

BRAIN



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THE BRAIN

The brain can be compared to the headquarters of the government, with its various departments, each with definite functions. It receives reports and sends out orders. It controls the muscles, the glands, the beating of the heart, the action of breathing. It registers what we see and what we hear. It is the seat of the higher functions of judgment, intelligence and will-power.

"response" without your having to think about it, are known as "reflex" actions. You will be able to think of a great many of them.

The Work of the Brain

We have left to the last that part of the government which has to feel, know, remember, consider, decide, and will. It is here that the human being is so superior to the other animals; these can breathe and digest, and have a whole outfit of reflex actions, and up to a point they can think; but none of them can compare for a moment with the human being in the qualities of the mind. The mind is not a bit of the brain; it is, rather, the word by which we described some of the things the brain can *do*—we might almost describe the mind as a ***property or quality of the brain***.

We have already shown that the ***internal*** affairs are carried on without your having to give your mind to them; and so we may now say that the mind concerns itself mainly with ***external*** affairs—the things that have to

be done so that the body can take advantage of its surroundings; among these affairs we must include the seeking of food, the avoiding or warding off of danger, and so on. Of course, the mind goes far beyond this, and thinks of music, art, astronomy, right and wrong, and thousands of other things—but the more backward and uncivilised races still give most of *their* minds to their physical needs, and to the "struggle to survive."

Your mind must have information of all the surroundings, and this information it gains through special "sense organs." If you can imagine a human being who had never been able to see, hear, smell or feel, you can see that he would almost certainly be an idiot.

Your sense organs, then, gather information. Your eyes are like tiny cameras which take moving pictures and send them to your brain; your ears notice and report vibrations of the air; your nose detects and reports smells; your mouth tastes; while your skin reports heat, cold, touch and pain. All the information is actually picked up by nerve cells and their fibres, and it is understood and remembered by nerve cells in your brain. The pictures "taken" by your eyes are conveyed to the brain, and it is there that you really "see"—that is to say, it is there that you know what the picture is and what it means; the same is true of the other sense impressions—you see, hear, smell, feel, and taste *with* your brain, though you are enabled to do these things by means of your eyes and other sense organs.

Your Cells as Citizens

Our illustration of the government is not, of course, a true picture of the brain. There are definite "centres" within the brain which are concerned with special senses and organs and activities, but everything is so very complicated and so linked up with other things that it is impossible to give a true picture. The body has been likened to a nation, the cells to citizens, the central nervous system to the government, and so on—but this has been done in order to make it possible to tell simply about things which are very far from being simple.

The Influence of the Glands

Fifty years ago no one had any idea that certain little groups of cells, glands that send their secretions directly into the blood, had any great influence on our bodies and minds. To-day we know that these glands may determine whether we are normally intelligent people or idiots, peaceful or quarrelsome, highly-strung and nervous or calm and placid.

These special tissues used to be called "ductless glands" because the "chemical messengers" (secretions called *hormones*) are collected directly by the blood flowing through the tissue—they do not flow out from the gland through a special pipe or "duct" in the usual way. Now, however, we know that among the glands which have ducts to carry away some of their secretions (their *external* secretions) there are some which produce in addition secretions which are collected directly by the blood from the gland tissue: in order to include these, too, it is better to speak of *all* the glands which make "chemical messengers" as *the glands of internal secretion.* The word *hormones* means "things which set in action." They can be compared to little keys flowing along in the blood until they find the right lock; each lock has its own special key and no other will do, and they must unlock the right door before they can deliver their message.

Good health and normal growth and development of body and mind depend upon the proper working of these glands, which work together like the musicians playing in an orchestra. The violin cannot take the part of the piano, but each is necessary for the proper rendering of the music.

We do not yet know all about what

these glands can do, but what we do know is most interesting, and important, too, as we are able to use the knowledge in the treatment of certain diseases. Here we can mention only a few of the remarkable achievements of some of the glands.

What the Glands do

The thyroid, which is in front of your neck and can be felt moving up and down when you swallow, can be compared to the accelerator of a car, because its hormones regulate the rate at which the body engine works. If the thyroid produces too much secretion, the engine " races " and uses up its fuel and repair material too quickly, and the body fires burn wastefully. If there is too little of the thyroid hormone, the engine only just " ticks over " and it doesn't provide enough power for the body and mind to work properly , the body fires are sluggish and we become dull-witted and listless.

A baby whose thyroid did not produce enough hormone would not grow and develop normally, and would be quite unable to learn lessons like an ordinary child of the same age. One of the greatest triumphs of medical science is to be able to cure this form of mental deficiency in a child or adult by giving a medicine containing some of the precious hormone obtained from the healthy gland of an animal Another gland (the pituitary) which is about the size of a pea, makes at least two powerful hormones. One of these controls the growth of your bones, determining whether you shall be a giant or a dwarf or just of normal size ; another acts on certain muscle tissue, including the muscle in the walls of the blood pipes, causing it to contract or " tighten up," and this of course affects your " blood pressure."

Two other glands (the adrenals) make a hormone that prepares you to deal with emergencies, to protect yourself by fighting or running away. An extra supply of this hormone is poured into the blood during excitement or fear or any other emotion. It makes the heart beat more powerfully and releases extra fuel (sugar) into the circulation to provide for a greater output of energy ; it makes you think and act more quickly and increases your muscular strength.

The pancreas is an example of a gland which has an external secretion (the digestive juice that flows through its duct into the small bowel), *and* an internal secretion or hormone. This pancreatic hormone controls the use of sugar by the body ; and when the hormone is deficient or absent (as in certain diseases of the pancreas) there is too much sugar in the blood and some drains away through the kidneys. This is the condition known as diabetes and the new insulin treatment is the use of an extract of pancreas which contains this hormone.

Health and Disease

So far we have talked about the body in health ; but the body has enemies—and, sad to say, we ourselves are often our bodies' *worst* enemies. We may neglect the body's needs of fresh air, exercise, proper food (well chewed and eaten at meal times only), rest, cleanliness inside and out, and we may poison it with too much alcohol or tea.

We are surrounded by enemy germs which will cause disease ; they are everywhere, but the body has its defences. Your white cells are ever ready to slaughter off invaders, and they are a very formidable army ; yet the body does not rely upon them alone. Many germs cause their damage by making poisons ; your body is able to make antidotes—substances which will render the poisons quite harmless to you. In addition to this, the body is able to create other substances, which make the germs more easily conquerable by your white cells.

To keep yourself free from disease, keep your body fit, so that its three means of defence may be as effective as possible.

Specially drawn for this work

TREATMENT FOR SHOCK

A condition of *shock* is a common effect of serious accidents, injuries and burns, and it is most important to know how to treat it, as a patient may die from shock. Here you see the essential *rest, warmth* and *stimulants* provided. The foot of the bed is raised to improve the circulation of blood to the vital centres of the brain.

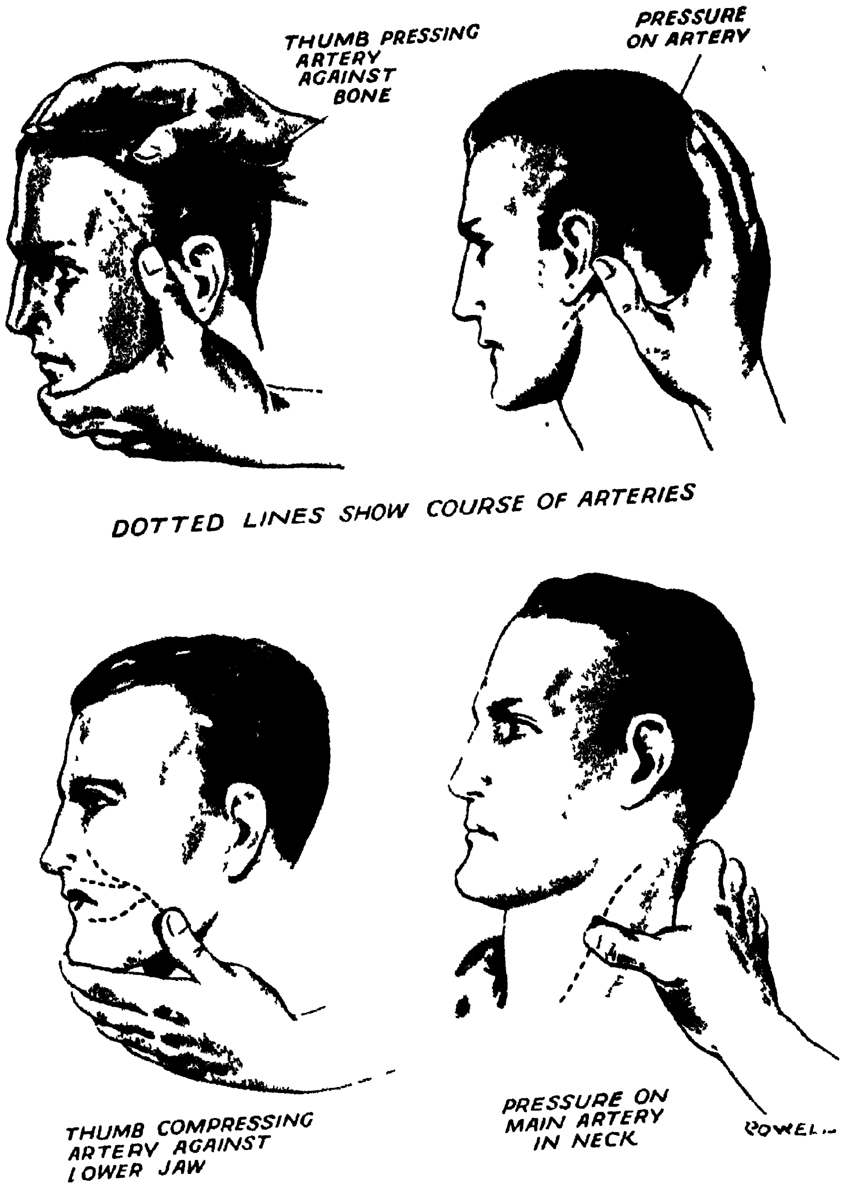
To give "first aid" means to give immediate help to anyone suffering from injury or sudden illness, such as a broken arm or a burn or a fainting fit, until the arrival of a doctor. The right kind of help given at the right time is most valuable, but you cannot give this help unless you have learnt what the correct treatment should be. In serious cases, such as poisoning or a broken bone, or severe bleeding, send a message for the doctor without delay, stating the nature of the trouble if possible. Then do the best you can for the patient until the doctor arrives.

What to do for Shock

After an accident or poisoning, or even after great emotion, the patient may suffer from "shock." He will be very pale, his skin cold and clammy, his breathing irregular and quick, and his heart-beat weak and rapid. You can feel the heart-beat in the pulse at the wrist by placing your finger tips at the base of the thumb in front. The normal pulse rate in health is about 70, but in a condition of severe shock it may be as high as 140. A patient in this condition will be only half conscious, with pinched face and sunken eyes.

Anyone suffering from shock needs ***absolute rest*** (lying down with the legs and hips raised above the level of the head), ***warmth*** and ***hot fluids*** to drink. If you cannot get him into bed at once, cover with coats, rugs or any extra

PRESSURE POINTS FOR CONTROL OF BLEEDING



Specially drawn for this work.

To control bleeding effectively—whether you are using your thumb or a pad and bandage or a tourniquet—you should know the most suitable places to apply the pressure to the artery which is carrying blood to the bleeding point. Where arteries are lying deep surrounded by soft structures, it would be most difficult if not impossible to apply sufficient pressure without injury. The best pressure points are where the artery lies near the surface and close to bone against which it can be compressed. Ambulance workers must know these points.

clothing available, and keep him lying flat, with pads (cushions or rolled clothing) to raise the hips and lower limbs. As soon as possible, he should be placed between warm blankets in bed, and the foot of the bed should be raised about a foot by supporting the ends of the bed on blocks of wood or piles of books. Provide hot-water bottles, and as soon as the patient can swallow, give hot fluids. Water alone is better than nothing, but if you can get hot sweetened tea or coffee, so much the better. Do not give brandy or whisky or wine.

Getting Rid of the Poison

In some cases of poisoning you must empty the stomach as soon as possible, to get rid of any of the poison that is still in the stomach. Sometimes you can cause vomiting by *tickling the back of the throat* with a finger or some other object, such as a feather or a piece of paper. If this method fails, and the patient can swallow, you should ***give an emetic*** (an emetic is something which causes vomiting).

Mustard dissolved in a tumbler of warm water—one teaspoonful for a small child up to a tablespoonful for a grown-up.

Salt dissolved in a tumbler of warm water two teaspoonfuls for a child up to two tablespoonfuls for an adult.

Warning.—Never give an emetic when the person has taken some poison which leaves stains or burns on the lips, mouth or fingers.

Specially drawn for this work

BLEEDING ARRESTED BY PRESSURE AT A JOINT

Here you see compression of the blood-vessels at the elbow by a pad held in position by keeping the arm flexed. The pad must be pushed up close to the joint.

Stimulants

In some cases where the heart is feeble, you will be advised to give a stimulant, which is something that makes the heart work better. Any of the following will do:—

Strong tea or coffee with sugar; give a cupful.

Strong beef tea, a cupful.

Sal volatile, ten drops for a small child, up to a teaspoonful for an adult, in a tablespoonful of water.

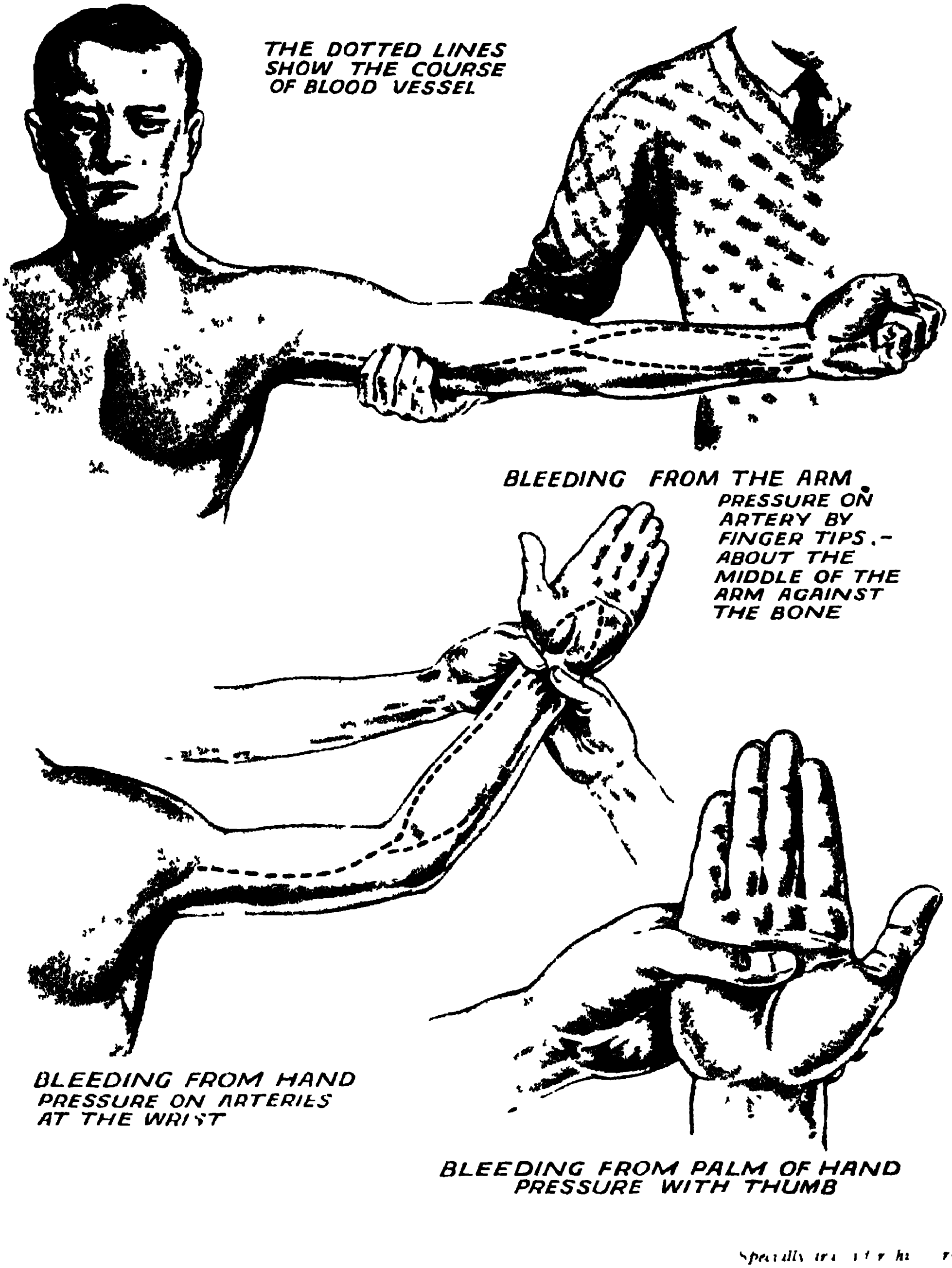
Artificial Respiration (see Drowning)

Bites

For a *dog bite*, pour iodine on the wound or wash it in water containing an antiseptic such as Milton, Izal, Dettol, etc. If the dog is ill, or has a dirty mouth, the doctor may have to give special treatment; so consult him without delay, and try to trace the dog.

For a *snake* (adder) *bite*, tie a handkerchief tightly round the limb between the bite and the heart; for instance, if the bite is on the foot, tie the handkerchief tightly round the leg. Keep the limb hanging down, and try to make the wound bleed by scraping or pricking it with a penknife or other sharp object. You can remove some of the poison by sucking the wound: the

BLEEDING FROM THE ARM OR HAND



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Bleeding from the arm can be controlled by pressure on the pressure point either with the fingers (as illustrated) or with pad and bandage or with a tourniquet. Pressure at the wrist to control bleeding from the hand must be applied to both the wrist arteries as shown in the diagram since these arteries join to form an arch in the palm of the hand and if one only were compressed, blood would still be carried to the wound by the other.

poison is harmless when taken into the mouth, provided you have no sore places through which it could get into your blood.

Give a stimulant (brandy, tea or coffee), and, if breathing stops, do artificial respiration (see under "Drowning").

Bleeding

A little bleeding, such as occurs from a slight cut on the finger or knee, will do no harm; it will be checked naturally in due course by the clotting of the blood. If, however, the blood is flowing freely, either in spurts from a cut artery or in a steady trickle from a cut vein, then you should try to check the bleeding without delay.

Bleeding can be stopped by pressure, either directly on the wound itself or on the main blood-vessel [artery] leading to the wound. You can exert pressure on the wound with the finger or thumb, preferably through a pad made from a clean handkerchief. If an antiseptic, such as Dettol, is available, dip your fingers or the pressure pad into it before touching the wound. You may be unable to keep up the pressure in this way long enough to stop the bleeding permanently. If possible, therefore, get the patient himself, or another helper, to check the bleeding temporarily in this way while you prepare a bandage. This may be used either to keep a thick pad in position over the wound or to tie round the limb so as to press on the blood-vessel carrying blood to the wound.

The pressure is needed at certain points between the heart and the injury, called "pressure points," where the blood-vessel can be squeezed flat against bone. The diagrams show you the main pressure points of the body. If you are using a bandage to check the bleeding, put some firm object, such as a smooth pebble or a flat cork, in a fold of the bandage immediately over the pressure point, and, having tied the bandage round the limb loosely, push a stick through the knot and tighten the bandage, just enough to check the bleeding, by twisting the stick. This type of bandage is called a ***tourniquet***. The pressure must be released by untwisting the stick every quarter of an hour, if the tourniquet cannot be removed before that time.

Bleeding from the Nose

In most cases no treatment is necessary; but if the bleeding is profuse and keeps on, the bridge of the nose should be bathed with cold water (ice water if available), and a cold-water pad should be placed on the back of the neck. The patient should sit up with head thrown back and breathe through the mouth. If ice is available, give him a piece to suck.

Bleeding from the Socket of an Extracted Tooth

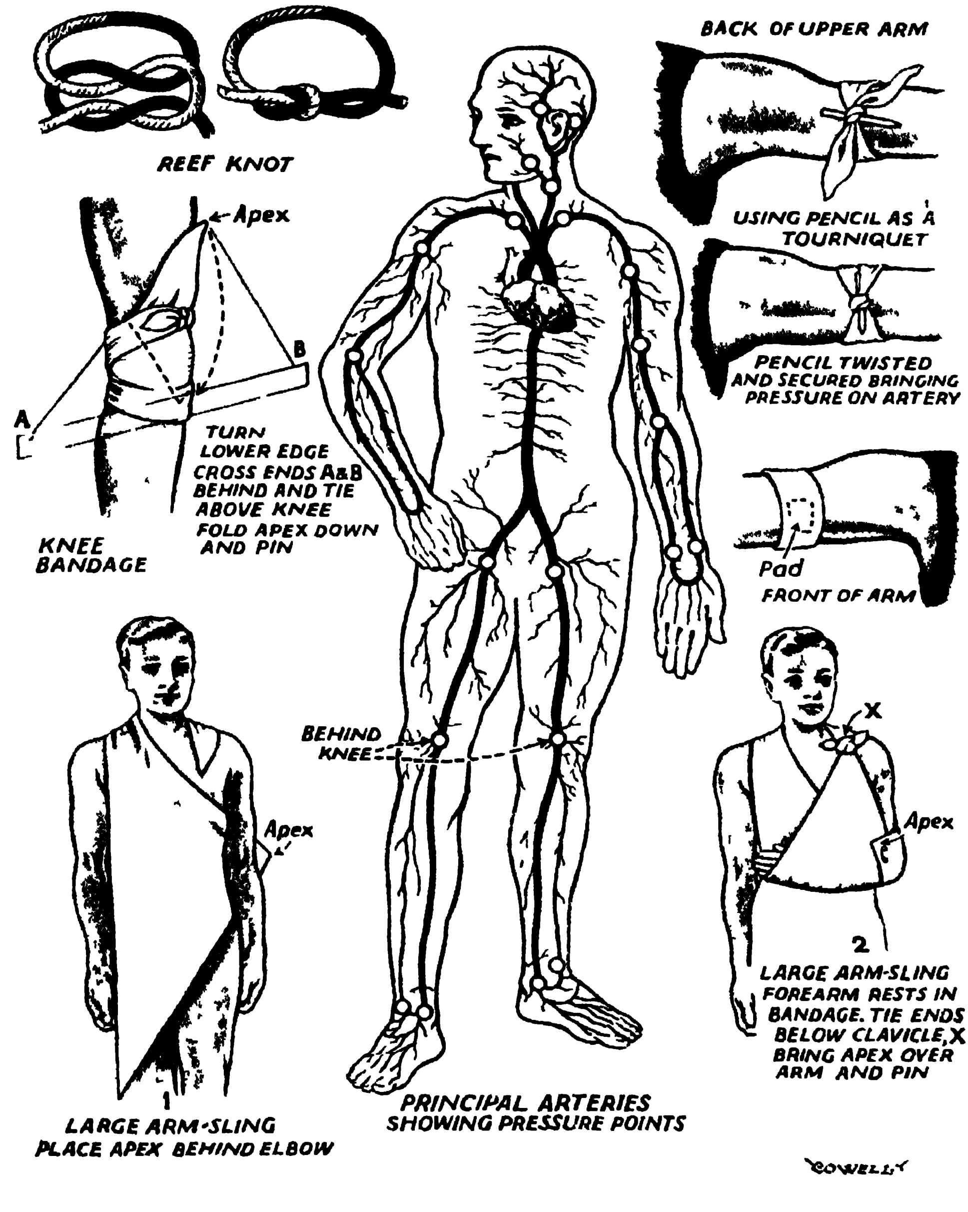
Plug the hole with cotton wool soaked in lemon juice or peroxide of hydrogen, or some other disinfectant, place a pad (a small folded handkerchief will do) over it, and tell the patient to bite on it, so as to press the plug firmly into the socket.

Burns and Scalds

If clothing catches fire, without a moment's delay smother the flames by wrapping over the burning part any clothes or rugs on which you can lay your hands; and prevent the person from running about. It is usually best to place him on the floor, with the burning clothes uppermost, and then roll him in rugs, blanket, shawl, tablecloth or anything else available, and keep him tightly wrapped until the flames are smothered.

If an acid or caustic fluid is spilled on the skin, drench the part immediately with water; then, in the case of acid, apply an alkali, such as milk of magnesia or washing soda solution, but for a burn from a caustic alkali put on weak vinegar and water, or lemon juice and

POINTS, BANDAGES AND REEF KNOT



Specially drawn for this work

In the drawing above the points where pressure should be applied to stop bleeding are shown by small circles on the main arteries. A tourniquet is used in the case of serious bleeding where digital pressure is insufficient. The tourniquet should never be left tightly applied for more than a quarter of an hour or the limb may be seriously affected. Bandages should always be tied with a reef knot, a simple rule for which is "right over left, then left over right" when the ends will lie in opposite directions.

water. Then dress the burn in the usual way.

To Dress a Burn.—If the skin is not broken, cover the burn with a dressing soaked in a solution of bicarbonate of soda (baking soda).

If the skin is broken, take care not to break any blisters, and do not pull off any pieces of clothing that may be stuck on the wound. Cut away clothing that cannot be removed easily, and cut round any parts that are stuck down. If the burn is on a part that can be immersed in a bowl of warm water containing a teaspoonful of bicarbonate of soda to each pint (temperature between 98° and 99° F.), soak the part in this warm bath; it will lessen the pain and shock, and will loosen the bits of clothing that are stuck down. Keep adding a little hot water to prevent the solution from cooling.

To dress the burn, cover the wound in strips of gauze or butter muslin soaked in solution of bicarbonate of soda. Let the doctor see the burn as soon as possible.

Shock from Burns.—The most serious effect of a bad burn, especially in babies and young children, is the condition of shock which is caused by the burn. Treat the shock (see p. 232).

Concussion. See Head Injury

Drowning

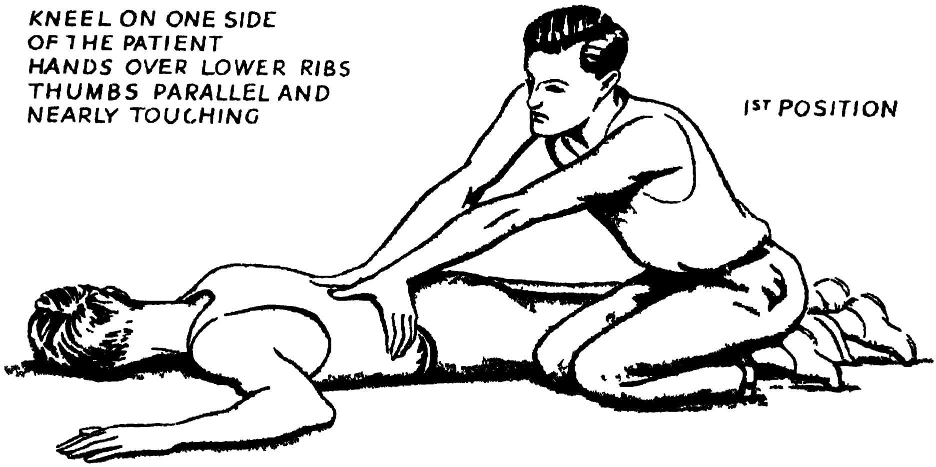
Anyone who has been under water for a period may appear to be dead when taken out of the water, but may recover if breathing can be started again. Attempts to do this, known as ***artificial respiration***, should be started

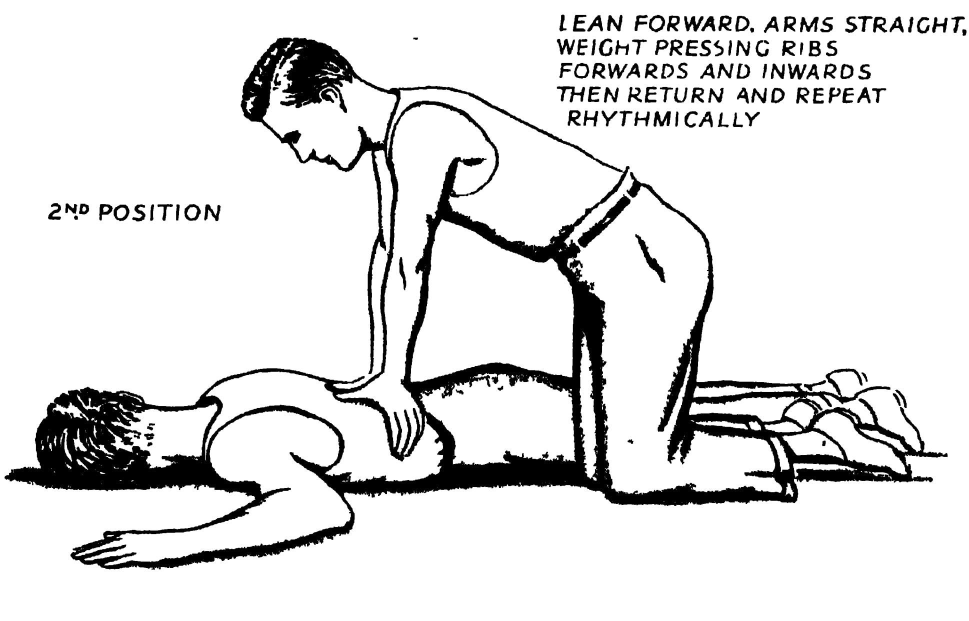
Specially drawn for this work

NOSE BLEEDING

A little bleeding from the nose will do no harm whatever, and may actually do good. Only if the bleeding is very profuse and shows no tendency to diminish is treatment required. Here you see sponges soaked in ice-cold water being applied to the bridge of the nose and the nape of the neck, while the patient sits upright.

ARTIFICIAL RESPIRATION





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Here you see the Schafer's method illustrated. First the mouth and throat should be quickly examined and cleared of weeds or other obstructions. The patient is placed face downwards and the chest is alternately compressed and allowed to expand, thus imitating the natural movements of breathing. It is better to kneel on one side of the patient so that, if a second helper is available, he can carry on without interruption while the first helper takes a respite. Time for the forward and return movements should be about 5 seconds.

as soon as possible after clearing the mouth of any obstruction such as weeds, etc., and loosening the clothing at the neck and chest; and the artificial respiration should be carried on for two or three hours if necessary. If other help is available, ***send for a doctor at once***, and arrange for blankets, hot-water bottles, hot tea or coffee.

Artificial Respiration.—You must try to reproduce the natural movements of the patient's chest when deep breathing. Place the patient in the position shown in the picture—head turned to one side and arms loosely extended—and kneel so that you can place your hands in the small of the back over the lower ribs. Now compress the chest as much as you can, to drive out the air (and any water that may have got into the lungs). You will do this best if you throw the weight of your body forward as you squeeze the chest, keeping your arms quite still.

Then remove the pressure by raising your body and arms slowly; this lets the patient's chest expand again, and air is drawn in through the nose. You are thus forcing the patient to breathe, squeezing air out of the chest and allowing air to enter again by letting the chest expand. Do the movements slowly, to imitate the normal rate of breathing, approximately twelve times per minute. If other helpers are present, take turns, changing over when you are tired.

As soon as the patient is breathing normally, remove the wet clothing and wrap him in warm blankets, with hot-water bottles, and put him to bed as soon as possible. Give stimulants (hot sweetened tea or coffee, etc.) only ***after*** natural breathing has started.

The treatment of the apparently drowned, then, is in two stages:—

(1) Artificial respiration, started immediately and continued for two or three hours if necessary.

(2) Warmth and stimulants after natural breathing has started.

Ear

Beads, peas, pencil ends, etc., are sometimes pushed into the ear by children. At the bottom of the ear passage there is a very delicate structure, the drum of the ear, which may easily be torn by unskilled attempts to remove the object. Therefore, unless the object is protruding so that you can get hold of it easily, do not try to remove it. Nor should you syringe the ear. Consult the doctor.

Eye

Bits of *dust or grit* may blow into the eye. *The eye should on no account be rubbed.* If you can see the speck lying under the lid or on the eyeball, very gently try to remove it with a wisp of cotton wool or the corner of a clean handkerchief, or a camel's hair brush. If it appears to be stuck in the surface put a drop of oil (castor or olive oil) into the eye, cover with a soft pad and bandage, and leave it for the doctor to attend to. Where the particle is embedded in the eye, there may be much less pain than when it is lying loosely on the surface, but there is a likelihood of germs getting into the eye and causing serious trouble. A doctor should be consulted as soon as possible.

If some ***chemical irritant***, such as acid, ammonia or quicklime, splashes into the eye, without a moment's delay the lids should be opened and shut several times ***under water***. The injured person can put his face into a basin of water to do this. After the eye has been thoroughly bathed, put in a drop of castor oil and cover with pad and bandage. Consult a doctor as soon as possible.

A "*black eye*" is really a bruise. It should be treated by cold bathing; and a pad of lint or a folded handkerchief soaked in cold water (ice water if available) should be bandaged over the eye.

Cuts or wounds about the eyelids may be bathed with plain warm water;

do not use an antiseptic unless the doctor orders this.

Fainting

A person who faints becomes unconscious because the brain is not getting enough blood, owing to the heart beating too feebly to pump sufficient blood up to the head.

Keep the patient lying down, with the head lower than the body if possible, so that blood can flow more easily into the brain. Give stimulants—smelling salts held to the nose and cold water sprinkled on the face, and sal volatile as soon as the patient can swallow. Don't let people crowd round, as the patient should have as much fresh air as possible. Loosen clothing at the neck and chest. A cup of hot sweetened tea or coffee should be given when the patient is recovering.

Fits

A *fit* (*"convulsion"*) *in a baby* or young child may occur quite suddenly; the eyes become fixed, the face purple, and the limbs and body stiff, and the child becomes unconscious. Send for the doctor. Meanwhile, place the child on a couch or bed and loosen or remove the clothing. Apply cold cloths to the head, and as soon as possible put the child into a warm bath, continuing to bathe the head with cold water.

A "stroke" or apoplectic fit in elderly people may cause a sudden collapse in the street. The face becomes deeply flushed, and the patient breathes noisily or snores. There is loss of power [paralysis] in one or more limbs, and when the patient recovers consciousness, he may be unable to move his limbs. Send for a doctor at once. Keep the patient lying down, loosen the clothing and give plenty of air. *Do not give stimulants.*

An epileptic fit may occur during childhood, middle or old age. There is a sudden fall, often preceded by a shrill cry. There is gnashing of teeth and irregular movements of the arms and legs. The patient foams at the mouth and he may bite his tongue, causing bleeding.

The treatment of an epileptic fit is to protect the patient from injuring himself. Put something (a pencil, handle of teaspoon or piece of wood wrapped in a handkerchief) between the teeth to prevent biting of the tongue. Pull any furniture, etc., out of the way so that he shall not bruise himself during the convulsions, and protect him from fire. *Give nothing by the mouth.* Allow him to sleep when the fit is over, covering him with a rug or coat.

A hysterical fit is not serious, and the patient is not at all likely to hurt herself. She is very noisy, screaming or laughing or crying alternately, and she may throw her limbs about wildly, and even foam at the mouth. Do not show sympathy or appear particularly interested. Speak sharply to her, and throw cold water in the face if she does not control herself. The patient should see a doctor later, as hysteria is a sign of ill-health; it is not "just pretending." At the same time, the best way to help her during the fit is to appear unconcerned; any show of sympathy will make her more violent.

Fractures

If the limb appears bent or in an unnatural position, and there is loss of power and great pain on movement, or if you have heard the snap of the breaking bone, you must get a doctor as soon as possible; and, if the patient is away from home, arrange for an ambulance or other conveyance if he is unable to walk. If he must be removed before he is attended to by a doctor, gently move the affected limb into a natural position, and make a splint from walking-sticks, umbrellas, rolled newspapers, or any other suitable object which is sufficiently rigid to protect the broken bone. If there is no wound, the splint can be put on over the clothing; but if the skin is broken, you should cut the clothing

if you cannot remove it easily, and dress the wound before putting on the splints. The splints should be well padded; they can be tied on with handkerchiefs.

Remember that if you have to straighten the limb to put on the splints, move the limb very gently and *never pull on it.*

Frost Bite

If your fingers, ears or nose become white and deadened with the cold, so that you have no feeling in them, *do not allow them to become warm suddenly.* Gently rub the parts with snow or cold water, and then *gradually* warm them with your hands or some part of your body. Do not go into a warm room until the parts have thawed and normal colour has returned.

Head Injury

A fall or a blow on the head may cause *concussion.* The patient looks very pale, and may vomit; he usually becomes drowsy, or he may be actually unconscious. The treatment is *quiet, rest and sleep.* Put him to bed in a darkened room, put cold cloths on his head, and send for the doctor.

If there is bleeding from the mouth, nose or ears, or if unconsciousness persists, there may be a fracture of the skull and serious *compression* of the brain. Treat as for concussion, but send an urgent message for a doctor. Until he arrives the patient should not be moved.

Heat Stroke

A patient who is exhausted by prolonged exposure to heat suffers from severe shock; he becomes pale and cold and may become unconscious. Treat as for shock.

Nose

Bleeding from the Nose.—See under "Bleeding."

Button, Bead, Pea, etc., in the Nose.—Children sometimes push objects up the nostrils and are unable to remove them. Let the child blow his nose vigorously, and let him smell pepper or snuff to make him sneeze; if you know which side is blocked, compress the free nostril with the finger. If this treatment fails to dislodge the object, *make no attempt to remove it yourself.* Take the child to a doctor.

If the object has been in the nose for some days before the child has confessed to putting it there, there may be a thick yellow blood-stained discharge.

Poisoning

Poisons act in different ways, and the treatment varies according to the type of poison which has been taken.

Corrosive poisons eat into and destroy the parts with which they come into contact, so that the lips and mouth are stained and burnt; and although we cannot see into the food-pipe and stomach, we know that they are similarly corroded. Therefore, in these cases, we must *never give anything to make the person sick,* because the injured lining of the food-pipe and stomach would probably tear with the movements of vomiting. Examples of corrosives are spirits of salt (hydrochloric), or of vitriol (sulphuric acid), carbolic acid, salts of lemon (oxalic acid), spirit of hartshorn (ammonia), quick-lime, caustic potash, caustic soda.

Irritant poisons cause inflammation of the stomach and bowel, but they are not so destructive as the corrosives. In cases of irritant poisons, we do give emetics to empty the stomach of the poison by making the patient vomit.

Narcotics act upon the nervous system, causing such symptoms as delirium, convulsions and unconsciousness.

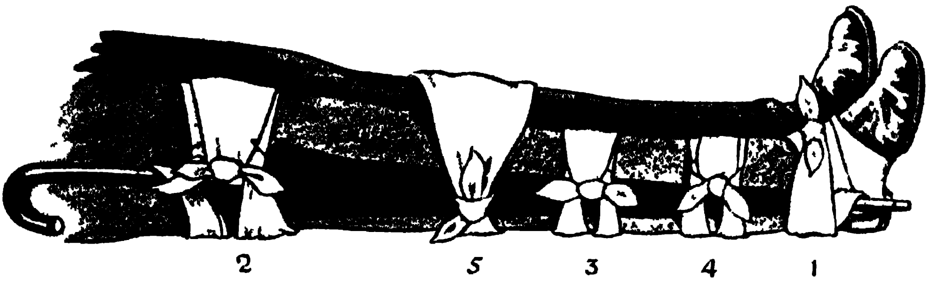
Some poisons are both irritant and narcotic.

Treatment.—(1) *Send for the doctor* immediately, explaining that you suspect poisoning, and naming the poison if known.

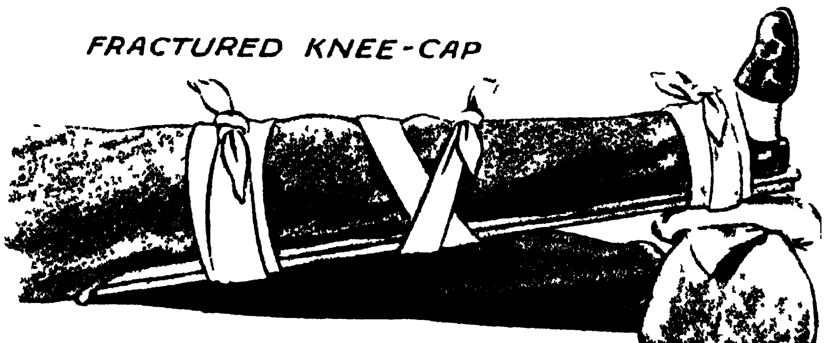
Note.—Save any vomited matter, or motions passed from the bowel, or

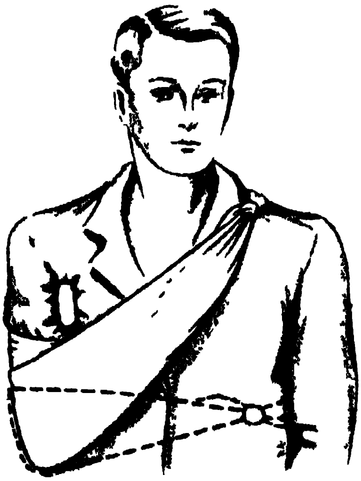
FIRST AID FOR BROKEN BONES

FRACTURE OF LEG BONE



FRACTURED KNEE-CAP





FRACTURED RIGHT COLLAR-BONE

FRACTURE OF UPPER ARM

ROWELL

Your aim is to keep the bone in a natural position with a bandage and sling or by the use of a rigid support—a splint—which can be tied in place with handkerchiefs, mufflers or any strips of material The splint should be well padded so that it could not injure the soft parts Splints can be made from walking sticks, umbrellas, the branch of a tree, or a cricket bat, hockey stick or golf stick. The numbers in the top picture show the order in which the bandages should be fixed.

bottles, glasses, etc., that have contained the poison.

(2) If the lips and mouth are not burnt, and you have no reason to suspect a corrosive poison, give the patient an emetic (see earlier paragraph on getting rid of the poison).

(3) If you know what poison has been taken, give something to make it harmless. We call this neutralising the poison, and the substance which does this is called the ***antidote.***

Note.—The following list gives the antidotes for some common poisons :—

Poison.	*Antidote.*
Corrosive acids	Chalk or whitening, milk of magnesia, lime water.
Corrosive alkalis	Vinegar, lemon juice.
Carbolic acid, creosote, turpentine	Epsom salts.
Opium, morphia, laudanum	Condy's fluid, solution of potassium permanganate.
Strychnine, foxglove	Strong stewed tea.

(4) *Treat the Symptoms.*—Stimulants and warmth for shock.

Artificial respiration if breathing has ceased or is failing.

Keep the patient awake if he is very drowsy.

Soothe the sore throat, stomach and bowel by giving raw eggs beaten in milk, or plain milk, or flour and water.

For pain in the stomach, apply hot fomentations or hot poultices or a hot-water bottle to the stomach.

The following plants (berries, leaves) are poisonous :—

Deadly nightshade.	Henbane.
Privet.	Foxglove.
Holly.	Spotted hemlock.
Cuckoo pint.	Yellow vetchling.
Bryony.	Woody nightshade.
Laburnum.	

Laurel.

If a child shows signs of poisoning after eating unknown berries or leaves, give the child an emetic first of all, then give stimulants and warmth. Later, a purge (dose of castor oil) should be given. Artificial respiration may be necessary.

Sprains

Apply bandages soaked in cold water, and rest the injured joint, using splints or slings where necessary. Let a doctor see the injury as soon as possible in case there is also a broken bone.

Stings of Insects

When the sting is left in the skin, remove it by pressing around it with the tube of a watch key or other suitable instrument.

Mosquito Bites.—Apply ammonia or sal volatile. If the skin becomes reddened [inflammation], bathe it with very hot water, or apply hot foments.

Wasp Stings.—Rub the part with a piece of wet washing-soda or the surface of a cut onion, or apply weak ammonia or sal volatile.

Bee Stings.—Apply vinegar or lemon juice.

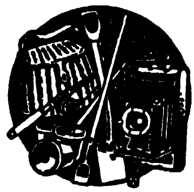
Sunstroke

If the head and back of the neck are exposed to the sun's rays in hot weather, high temperature, giddiness, weakness and sickness may result and be followed by drowsiness or unconsciousness.

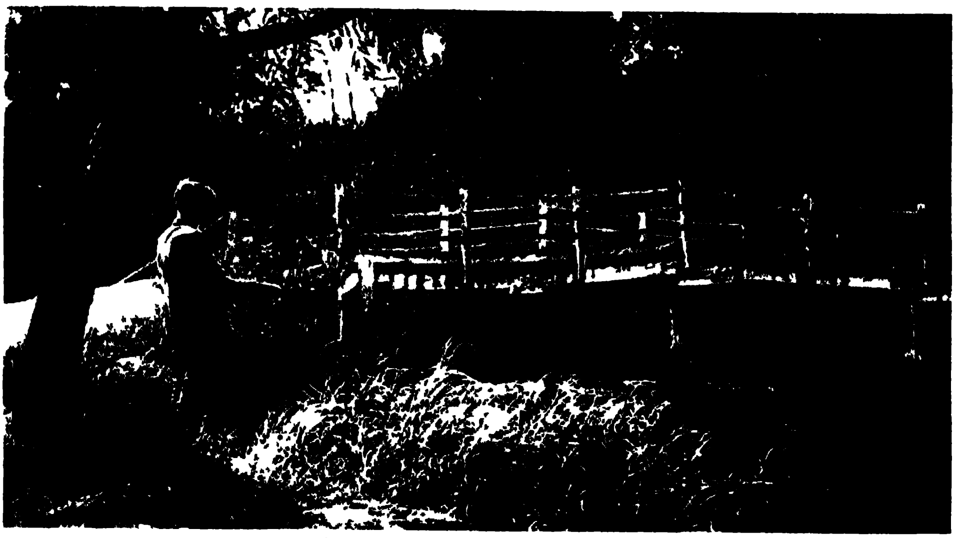
Treatment.—Take the patient to a cool, shady place, and remove his clothing. Douche the head, neck and spine with cold water or wrap him in sheets soaked in cold water, or put him into a cold bath.

When he has recovered consciousness, and the temperature has fallen to 102° F., put him to bed between blankets, and keep the room darkened. If he again becomes unconscious, renew the cold applications, and if breathing ceases, do artificial respiration. Give water to drink (***not stimulants***).

Favourite Hobbies: Pastimes at Home and Out of Doors



Fishing, Gardening, Photography; Butterflies and Moths; Coins



Topical Press

FISHING FOR TROUT AT FLATFORD BRIDGE

Angling is an art, a sport, a science, or an amusement: a recreation for seekers after peace and quiet, or it may be an exciting pastime on occasion. As a sport its history is lost in antiquity, and to-day it has more followers than ever before. Something of its lure and the methods of the fisherman in fresh or salt waters is described below.

THE ANGLER'S ART

ANGLING, says the dictionary, is the art or practice of fishing with rod and line. The word is particularly used for the capture of fish as a sport and recreation as distinct from fishing as a business.

No doubt when angling first began primitive man was much more concerned with obtaining food, but even in the days of the ancient Egyptians, Greeks and Romans the sporting side and the arts and wiles required to lure the fish were properly appreciated. Studious men of bygone times found they could contemplate Nature and reflect on its wonders while trying to catch fish which would make a meal. Monks of medieval days were renowned as anglers.

In this country, as in others, a whole library of books has been written dealing with this "gentle art." So long ago as 1496 a "Treatyse" on Angling was written, and one of the most famous of our English classics is "The Compleat Angler," written by Izaak Walton, and published in 1653. "Most Anglers are quiet men and followers of peace," Izaak wrote, and added later: "God never did make a more calm, quiet, innocent recreation than Angling."

As a sport, Angling has several branches to-day, but they can be

broadly separated into three main divisions: Coarse Fishing, Fly-fishing and Sea Angling. The first is probably the most largely practised, while fly-fishing is commonly regarded as even more sporting and more fascinating than any other form, though each will argue according to his tastes, and it is quite certain that each has its own particular charms.

Generally speaking there are two fish which are the object of the fly-fisher: Salmon and Trout. But there are a number of other fish which may be taken with the fly though they do not come into the category of "game fish" as salmon, trout and grayling are termed.

In this country salmon is rather outside the sphere of the average angler and for this reason when one speaks of fly-fishing it is generally assumed that trout is the object of the angler's wiles.

When Close Seasons Vary

All freshwater fish, except salmon, trout, char and grayling, are usually termed "coarse fish." The origin of this term is uncertain, but was quite probably applied because of the comparatively large scales which most of them have. Pike are fished for with small fish, dead or alive, or representations of them, but they can be classed with the coarse or general fish, the best-known of which are the Roach, Perch, Barbel, Chub, Dace, Gudgeon, Carp, Tench, Bream and Rudd. Most of these fish frequent rivers, lakes and ponds, but barbel are usually found only in running water, while dace rarely thrive in lakes. Chub, too, are usually found in flowing streams rather than in lakes or ponds.

There are close seasons for the different kinds of fishing, but the actual dates given in the calendar may be varied by the local authorities for good reasons. For coarse fish the close season is from March 14th to June 16th. Actually, any coarse fish caught during this period are worthless and afford very little sport. Generally speaking, September and October are the best two months of the year as it is usually about August when they begin to get into first-rate condition.

Trout cannot be fished for in England between October 1st and February 1st, but it is often mid-April before trout are in their best condition. The close season for salmon begins on September 1st for nets and at the beginning of November for the anglers with rods, both ending on February 1st. But all these dates may be varied by the responsible authorities in any area where it is considered advisable Different dates apply in both Scotland and Ireland

Tackle for Coarse Fishing

Leaving fly-fishing for a time and coming to the question of the implements required for coarse fishing, there is nowadays an almost bewildering variety of the first and most important article in the angler's outfit: the rod. Stories of boys making better catches with a long bamboo rod and a cheap line with a bent pin for a hook are probably true enough, since luck plays a big part in angling as in any other sport. So, too, do knowledge and experience!

Local conditions may influence the choice of tackle and the beginner will be wise to seek advice from some friendly angler in his own district. Generally speaking, however, the ordinary 3-jointed rod, 11 to 14 feet long, is right for the general angler. The main point about the rod should be that the balance feels just right to you. Before trying the rod you have in mind it is as well to choose your reel and have it fitted in its place on the butt as the reel naturally makes some difference to the general balance. The butt should have a cork handle as this gives a much better grip.

Your rod will be fitted with rings for the line to run through and the type known as bridge rings are better than the snake variety. If you can afford

to have the porcelain-lined rings there is less chance of the line becoming fouled. In any case it is wise to have the top ring, right at the end of the rod, as well as the one next to the reel, lined with porcelain. It is a good plan to rub the joints of your rod occasionally with vaseline to prevent them from sticking.

Float, Hook and Sinker

The reel, or winch, is a matter of taste and the cost varies considerably. A 3-inch or 3½-inch reel is about the right size for a medium sized rod and it will hold 50 yards or so of fine line, which is ample for the average angler. A silk line is generally used and it is well to bear in mind that after being used the line should be properly dried. Coil it round a chair-back at home, or, better still, make a drier for yourself, and then when winding it on the reel again make sure there are no loops or kinks and that it is reeled quite tightly after drying.

This line needs two other fittings, a float and a hook. The hook is usually attached to a length of gut when bought and this gut has to be fastened to the silk fishing line. The tying-on must obviously be done securely, and if you can get a friend who is an expert in knot-tying, or has had experience of the task as an angler, so much the better.

As a general rule the line must be leaded with shot. This shot is usually bought ready split for the purpose. A pair of pincers will make it fit tightly on the line. As in the matter of knots, it is well to have advice from the dealer or a friend on the size of hooks you should buy. He will know the waters you are likely to fish and the kind of catch you may hope to get.

The object of the shot is, of course, to sink the line and partially submerge

Fox Photos.

YOUNG ANGLERS AT SEVEN ISLANDS POND

There is a story behind this picture which was taken at Mitcham in Surrey. High authority decided to use the pond in connection with some agricultural plan, but the youngsters appealed against a decision which would rob them of their fishing rights. They gained their point and official sanction was granted for the ancient pastime to continue at the pond.

Fox Photos

YOUTHFUL COMPETITORS FOR ANGLING PRIZES

Fishing is sometimes regarded as a lonely recreation but there are times when it draws the crowd. Here is a picture, taken on the River Ouse amid the pleasant countryside outside Cambridge, in which we see a section of the 800 youthful competitors who took part in the Angling Society's annual juvenile competition

the float in water. Just how many shot should be used depends on the size and type of float used and can really only be found by experiment, but an average of four or five is usually necessary. In very still waters some anglers will have no weight at all on their lines, but the float in this case is weighted at the lower end.

There are all sorts and sizes of floats: pretty ones made up of quill, or big ones of cork and wood, often used for pike-fishing. The porcupine quill with light, painted cork body is popular or a quill alone is often used. The float is usually kept in position on the line by a float cap, a quill ring or a small rubber ring.

With a good rod and line, properly fitted, the angler has practically everything that really matters except bait. There are a few other items that may be needed and are on occasion very necessary: a plummet which can be used for finding out the depth of the water in which one intends to fish, or a landing-net, which may be useful for lifting fish into the boat or on to the bank. A fishing-basket, known as a creel, or a bag, will be desirable for the big catch you hope to get when setting out.

Preparing the Bait

Having your tackle there remains one other important item, and that is the question of bait with which to lure the fish. Ground bait is food which is thrown in before and during the time when the angler is fishing and is intended to attract the fish to the particular part of the water selected by the man with the rod. Usually this ground bait is made with bran mixed with breadcrust, and perhaps cheese rind and similar odd scraps. These should be well broken and soaked in water to be made into stiff balls. For

the hook bait use gentles, worms of different kinds, or a paste made with ½-pint wheat soaked in cold water and very gently stewed for four or five hours, adding more cold water about once an hour. Gentles can be bought and so can worms if one cannot easily obtain them otherwise Local anglers will advise you on points such as these

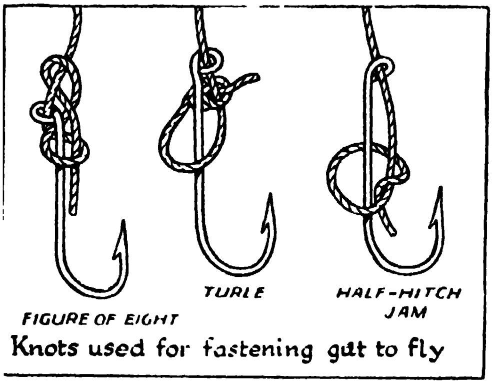
The ground bait is used first, one of the balls being broken in half; then put in a little of the bait it is intended to use on the hook This half-ball is made into another ball about the size of an egg This ball can be gently thrown into the water or, better still, lowered into the water after squeezing the ball gently on to your fishing line at the hook end A sharp jerk of the rod when the line is sufficiently far down will release the ball of bait and the line can then be withdrawn.

The place where the ground bait settles is where the fish will gather Three or perhaps four balls of ground bait may be used before the hook is baited. Probably before then the angler will have tested the depth of the water with the plummet, fastened to the line, if he is in doubt about the depth The float can then be adjusted so that the bait will rest a couple of inches or so off the bottom, allowing a little for the fact that the water will probably carry the line a little way. The line will be weighted with shot so that the float will remain an inch or so above the water.

The hook should be well covered with bait. If you are using a bait of wheat paste it should be firmly moulded round the hook. Now the line is cast by an underhand or round swing from the rod tip Hold the rod in the right hand and the baited hook in the left, then swing the rod forward and release the hook at the same time. Let it settle and when the float is in its right place in the water see that there is the least possible amount of loose line between the end of the rod and the float

ROD AND LINE IN LONDON'S SUBURBS

Our picture would scarcely be chosen for a London scene yet it was taken at Grovelands Park in the suburb of Southgate The lake is used for boating and fishing, and here we see young anglers taking part in a competition organised during their holiday time



TYING THE HOOK

Artificial flies are usually bought tied to the hooks and here are shown three different ways of securing the eyed hook to the line

Different Styles for Different Waters

Ground bait should be thrown in occasionally and further casts can be made with perhaps more line so that a fairly wide area is covered. When a fish bites, the float will dip or go under water; sometimes a little preliminary nibbling by the fish will warn the angler, but as a general rule he must strike promptly, the point of the rod being brought up quickly without jerking it. Never let the fish have any slack line and try to keep it from coming to the surface until you are on the point of landing it

There are different methods or styles of fishing adopted on different rivers, such as the Thames, Lea, Trent and the Midland rivers. One well-known style is known as Nottingham fishing and is no doubt specially suitable for some waters but not for others. About these different methods and particularly about the peculiarities of his own district, the beginner will learn as he progresses in the art.

In angling, as in most other arts and crafts, experience is the best of all teachers. If one can have the advantage of a few hints from an expert, especially about the waters in which one intends to fish, it will be a great help.

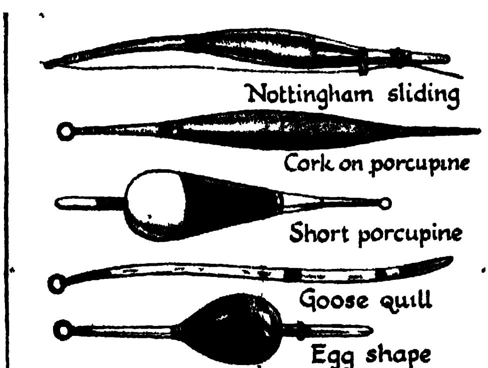
Roach is probably the most popular fish with the general angler. Nearly all rivers have a minimum size limit for the different fish, and all catches below that limit should be returned to the water at once, unless of course, the angler is anxious to secure live bait for pike or for perch.

Fly-fishing

There are a number of fish which can be caught by dry or wet fly-fishing, and the main ideas on which all fly-casting is based are very much the same for all fish. Salmon fishing would perhaps be placed at the top of the list as the most exciting form of the sport, but the best salmon rivers in the United Kingdom are in Scotland and Ireland, though there are several rivers in England on which the sport is enjoyed.

Most of the salmon fishing in the British Isles is privately owned, and for this and other reasons it is unlikely to become a popular form of fishing When one speaks of fly-fishing it is usually taken to mean for trout, though there are several other fish that can be taken with fly Many anglers, once they have become victims to the fascinations of trout-fishing with wet or dry fly, have little interest for any other branch of the sport.

One curious point is that in trout



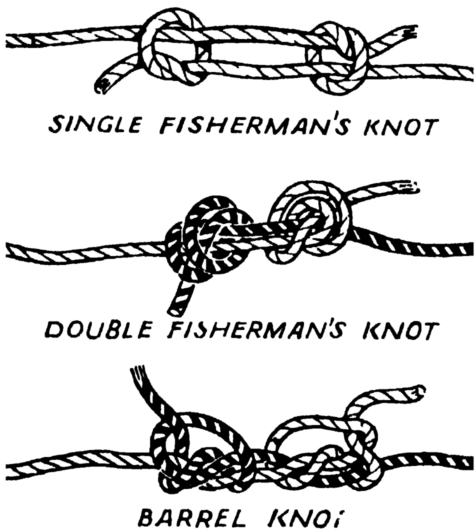
DIFFERENT TYPES OF FLOAT

There are various kinds of float used in general fishing from the small light quill to the heavier cork and wooden float used by the pike angler.

fishing the artificial flies used by the angler must resemble as closely as possible the insects which seem to be most popular with the fish as dainty morsels of food. In the case of the salmon there is no question of tempting the appetite of the fish; the fly is merely used as an irritant. During its stay in fresh water the salmon is usually a bad-tempered creature, and amongst the things that annoy it are brightly coloured objects, especially gaudy insects. So the flies for salmon fishing are made as brilliant as possible, while trout flies are usually of sombre hues but tempting to the trout's taste.

Tackle for Trout

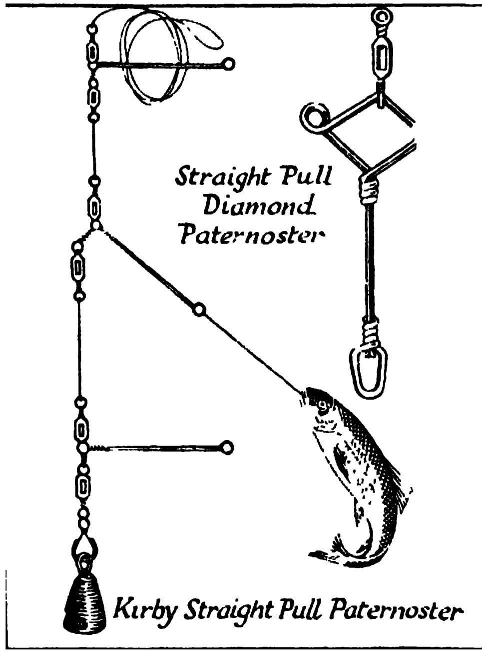
Trout vary in size in different waters Rapid streams tend to produce small fish and a half-pounder may be considered as one of reasonable size. In other waters such as the chalk streams of Hampshire, a 2 lb. fish would not be regarded as anything very wonder-



Knots used for joining gut

HOW TO TIE SECURELY

Knots are important in all branches of fishing and in the diagram above three of the most useful knots for the angler are given.



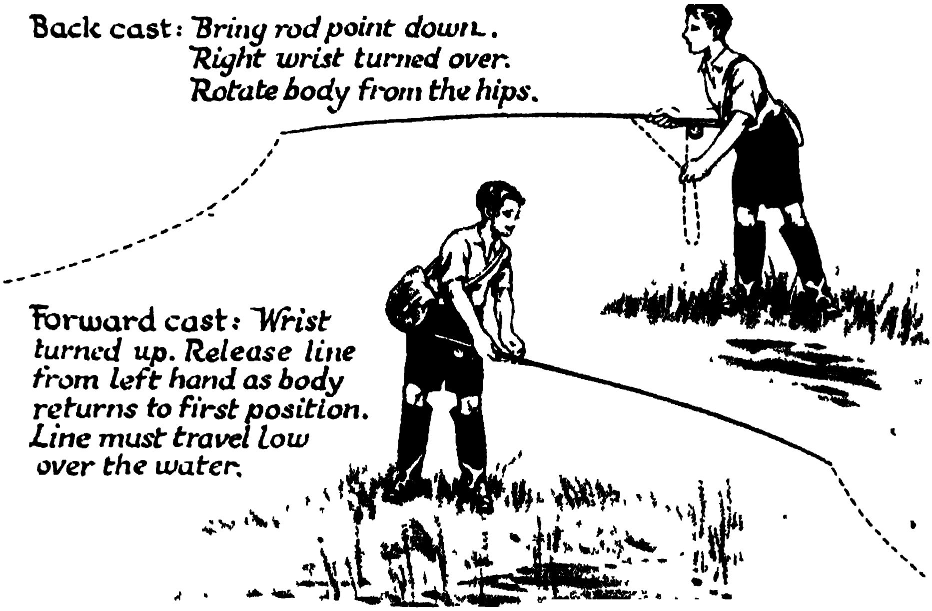
USED IN SEA ANGLING

Paternoster tackle is largely used in sea-angling, and in the drawing above two types of this particular kind of tackle are shown.

ful and a half-pound fish scarcely worth mentioning. The record size is generally accorded to one of 39½ lb. taken in Loch Awe in 1866, which is a long time ago, and may account for the fact that doubts have since been expressed by sceptics who do not question the weight of the fish but suggest it may have been a salmon.

So far as the indispensable tackle is concerned the list for fly-fishing is not unlike that used by the general angler: rod, line and reel come first as they do in most forms of angling. In addition, the silk-worm gut casts which will be tied to the line are necessary, and, one of the most important items of all, a selection of artificial flies. A landing-net, too, is a necessity, and a wicker creel or waterproof bag in which to take back the day's catch should be put on the list.

A box or waterproof pouch in which the casts can be safely kept and another



Specially drawn for this

HOW TO CAST WHEN BAIT-FISHING

Like every other interesting sport or recreation there is much to learn about the right and wrong methods in angling In the sketches above our artist illustrates the way in which the young angler should manipulate his rod when throwing the line After casting keep the rod tip down till the float has settled then raise the rod until there is a minimum of loose line between float and rod-tip

box or case to contain the flies will also be needed. These items are matters for individual choice, just as the various gadgets for the angler's convenience may appeal to one person and be despised by another.

A 3-piece, split-cane rod of about 9 feet in length and 6½ oz in weight would be an appropriate kind to buy, though a greenheart rod is generally cheaper and by some people regarded as equally satisfactory. While it is good advice to say "Get the best rod possible," it may not be so wise in the case of the beginner, who will only find out by experience just what type of rod he really prefers. Probably the safe plan is to get a moderate-priced rod to begin with and this may, of course, serve for a long time.

As with most sporting implements, the great thing is to get one that feels right to you so far as balance is concerned. A friend may advise you in many ways, but you are the only one who can judge the feel of the rod in your own hands, after the reel has been fitted. It is worth buying a good reel for the simple fact that it may last you a lifetime. Make sure that the reel will suit the balance of the rod.

A Large Choice of Flies

Lines can be fairly expensive, but again the beginner will be fairly safe in buying a good standard make of double-tapered 30-yard line. The cast comes next, usually a 3-yards length of silkworm gut, generally looped at the thicker end for fastening to the line. Thickness is described as X or 1X down to 5X or finer lines; the higher the number the finer the line. "Fish fine" is good advice, but it can be

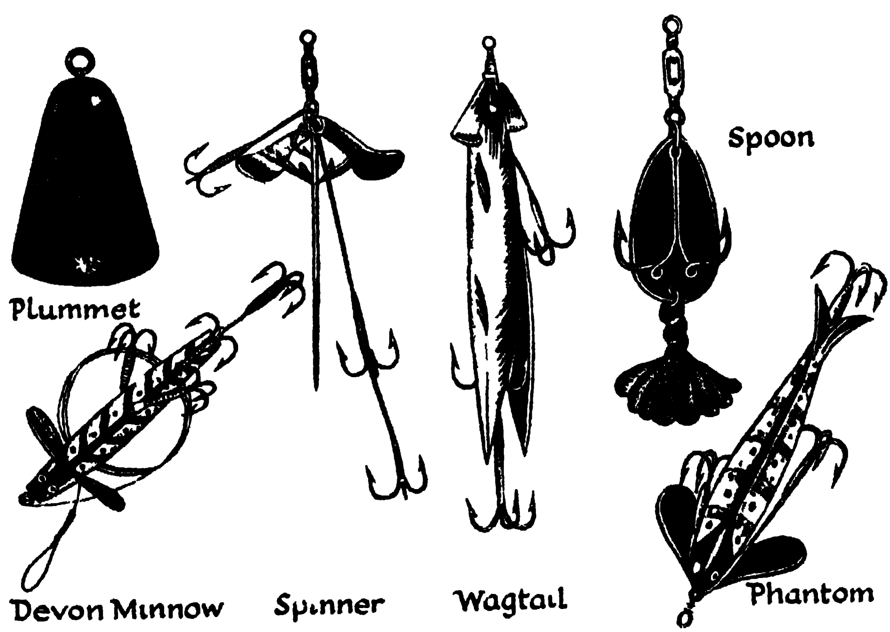
carried too far, especially in the case of a beginner ; 2X is probably fine enough The cast should be soaked in water before starting out Sometimes an angler will soak the gut cast in lukewarm tea to stain it brown, thus rendering it less visible to the fish General fishermen, too, sometimes adopt this device

Artificial flies are usually tied upon eyed hooks so that they can be quite easily attached to the cast A book might easily be written on this subject of flies which attract trout at the different seasons The main point is that the angler should use one of the flies that appear about the time when he is fishing At the end of May or beginning of June for instance, the Mayfly arrives—a big fly which is taken greedily by trout during the few weeks of early summer Other flies are made to imitate the nymphs or the immature stages of these flies

There are many other flies from the March Brown and the Blue Dun or Greenwell's Glory of April to the Cinnamon Quill and Silver Sedge of August and September But there is a big selection of flies which can be used in both dry fly fishing and wet fly-fishing, and a knowledge of these, as well as the personal preferences of different anglers, is one of those matters on which experience alone is the road to knowledge

Concerning the Different Methods

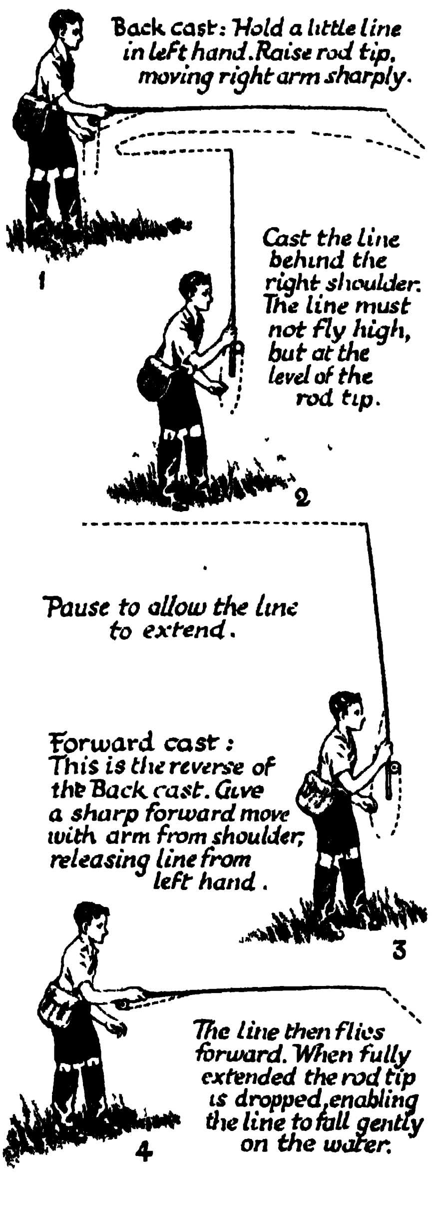
Here we are concerned only with a general outline of what is necessary Actually there are broadly three main methods of trout-fishing with a fly: the Dry Fly the Wet Fly Upstream, and the Wet Fly Downstream These



Specially drawn for this work

SOME OF THE BAITS USED WHEN SPINNING

One form of fishing which has become increasingly popular is that known as spinning For pike it is probably the best and most sporting method but it can be used for other fish as well including salmon trout and perch according to circumstances The bait is an artificial spinner of which the spoon type is probably the oldest, and with the Devon minnow among the most popular In the top left hand corner is the plummet used in general fishing to ascertain the depth of the water



THE ART OF CASTING

The first lesson the would-be fly fisherman has to learn is the correct way to cast his line so that the bait will fall quietly on the water. In the above four sketches our artist has illustrated the method generally used.

terms largely explain themselves and the question of which is the best method or whether all are best in their turn, according to circumstances, is a matter of taste or possibly argument.

In the first the fly is cast just ahead of a rising fish. To make the fly alight naturally and gently on the water it is a good plan to cast at an imaginary spot about a foot above the spot on the water on which you wish your fly to alight.

Trout always lie in the water with head upstream; the angler naturally stands behind it since it is important that he should not be seen. He casts his line in such a way that the dry fly, falling lightly and quietly on the surface of the water a foot or two in front of the fish, will float gently down quite naturally over the fish, and if he is the sort you expect him to be he will promptly take your fly.

The angler should not be in too big a hurry to strike; in smooth water he gives the fish a reasonable chance to suck the fly fairly into its mouth. Then a twitch of the rod and the trout is safely hooked. It sounds simple enough on paper, but to become expert needs a good deal of practice and the beginner is apt to strike too quickly, especially on slow-moving streams.

For Wet Fly Fishing

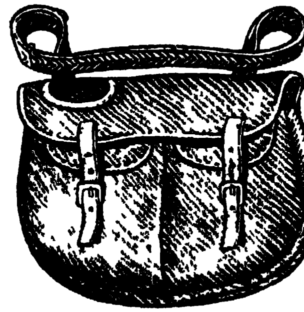
Some elementary knowledge of flies is useful to the angler. Dry fly-fishing is usually carried out with an imitation of the mature fly, but in fast-running streams the trout feeds mostly on flies in the nymph stage as they struggle from the water to the air above where they can stretch their wings. Rather a different type of imitation fly is needed in these more turbulent streams, and instead of the wings being outspread they are tied close together to form what is really a single layer. The cast should be moistened with river mud and even the fly itself may be treated lightly in the same way so that it will sink under the water and not, as in dry fly-fishing, float on the surface of the stream. It is usually necessary to wade in the waters to be fished and suitable waders are another necessity.

Downstream fishing is often easier

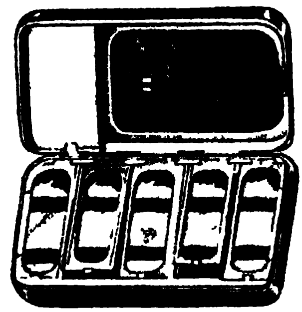
for the beginner than is any other form. Casting the line is not so difficult as it is made across the water and the current does for the fly what the craft of the expert does in the other forms of fishing. But downstream fishing is only suitable in certain circumstances, when rivers are swollen, for instance, and unsuitable for either dry fly or for upstream fishing, though the trout may be plentiful enough.

Another kind of fishing for trout is known as spinning. In this case an imitation small live fish is used as bait. This is so made as to imitate the turning or wriggling movement of some of the commoner kinds of small freshwater fish. These man-made imitations have various names, among them being "Spoons," which revolve by their shape; Devon minnows, shaped roughly like a fish; Phantoms, which are more exact imitations of the real thing; and Wagtails, which are made of pliable rubber.

The rod used in this kind of fishing is usually shorter and stiffer than one employed for fly-fishing, especially if the angling is being done from a boat. Reels, too, are rather more important as there are certain snags in spinning which can only be avoided by having a suitable automatic reel. Even the reel does not help in such matters as the avoidance of "kink" in the line, caused by twisting. For this reason the spinner usually has his line leaded, and the question of just where to put this weight is often a difficult one. In certain cases the lead can be attached to the swivel fitted to the artificial bait to enable it to do its spinning as it is drawn through the water.



Trout bag



Fly box

Baiting the hook

ANGLING ITEMS

Two articles of equipment necessary for the fly-fisherman are a bag for the catch and a box in which his artificial flies may be kept. The third drawing is for the general angler and shows how the hook should be baited.

A Good Eye for Water

Only certain types of water are suitable for spinning and generally speaking this particular form is not used except in cases where the more usual methods of fishing are unsuitable. Often enough on good fly-fishing water spinning is prohibited for the simple reason that it would make fishing with fly impossible or very nearly so.

Among trout anglers there will be

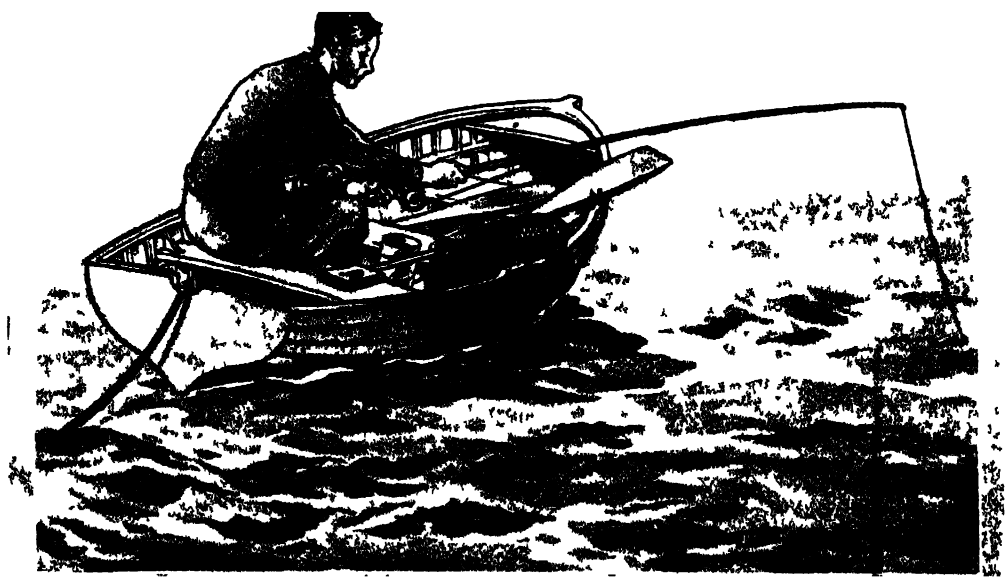
found many who have practised the art in all its forms, not excluding fishing with worms Here again it can be said that in certain conditions this method may be the best, even though the fly fisherman may consider that he is not treating the trout with the respect he has hitherto accorded the fish

The best advice, of course, is to be gained from the experienced fisherman who knows the water where one hopes or intends to fish No mere printed words can explain and illustrate the correct way of casting or landing or even tying Only experience can give the angler " a good eye for water " or that instinct which tells one just where fish are lying in wait for the tempting fly skilfully cast by the quiet angler

Sea-Angling

There are many holiday-makers who indulge in an occasional break at fishing when at the seaside, but it is usually of a very casual kind A hand-line trailed over the back of a boat or the edge of the pier may yield catches and a certain amount of pleasurable amusement, but it scarcely comes in the category of first-class sport.

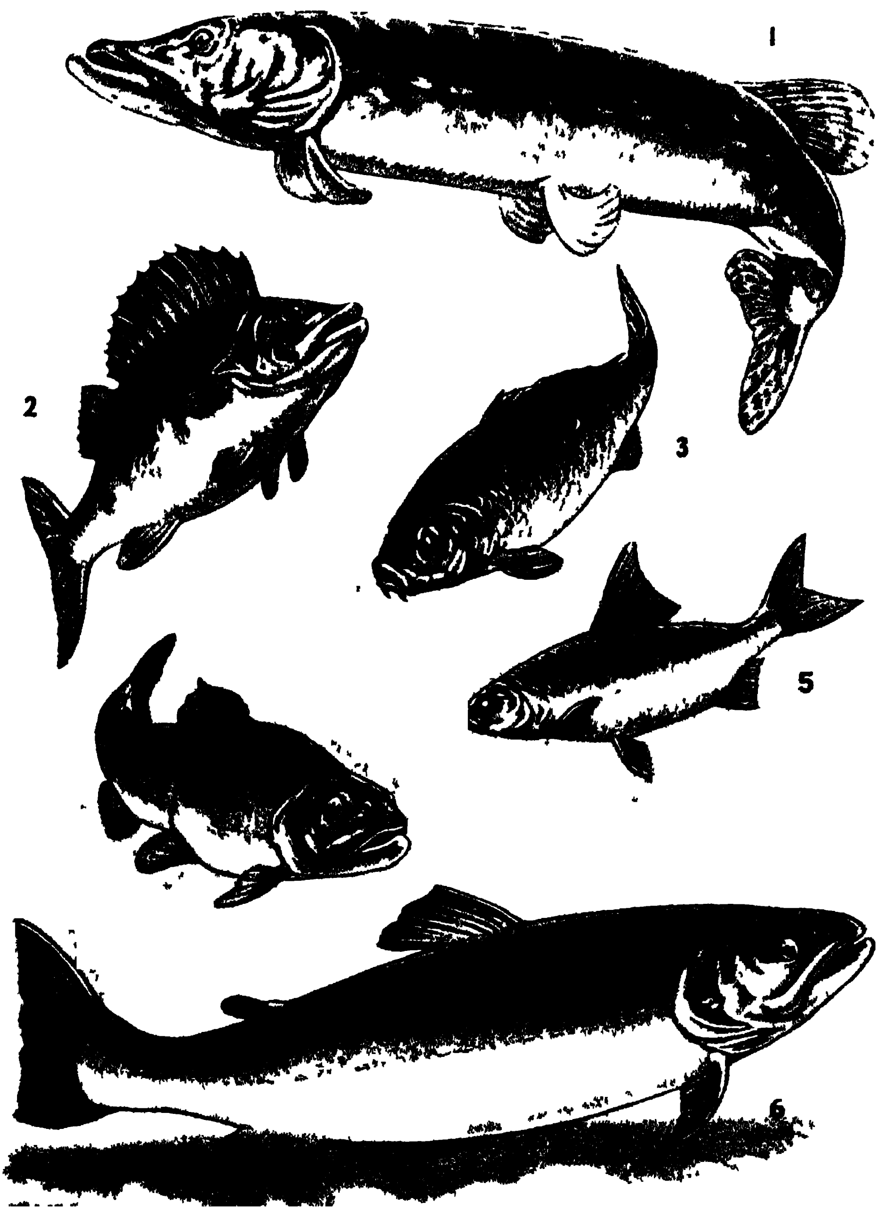
Rod, reel and line are the equipment of the true sea angler, just as they are of the general and fly-fishing brothers of the Angle, as Izaak Walton called them In choosing a rod it will depend on what kind of fish you are intending to lure Usually the sea-angler's rods are short and stiff, probably 7 to 8 feet in length, made in two joints and generally of greenheart If you have another top for this rod you will be equipped



SEA-ANGLING FROM A BOAT

Both methods and tackle of the sea angler differ from those of his brother sportsman who prefers the quiet streams and lakes inland The sea angler may indeed dispense with a rod and trail a handline on occasion but rod, reel and line are usually employed The rod is normally both shorter and stiffer and the line much longer and generally fitted with the paternoster tackle seen on an earlier page

BRITISH FRESH WATER FISHES—Plate



Specially painted for [illegible]

Life on this earth began in the waters long before the earliest man had appeared, and it was the fish that first developed a backbone. Other animal types developed on land and many of them have vanished in the struggle for existence, but in the sea and the rivers the fish has increased and multiplied. In this Plate we have some of the well-known fish [illegible] rivers and lakes: 1 Pike, 2 Perch, 3 Carp, 4 Trout, 5 [illegible], 6 Salmon.

BRITISH FRESH WATER FISHES Plate 2

[illegible]

[illegible]

BRITISH FRESH WATER FISHES—Plate

Spe[illegible]ally [illegible]

[illegible]

BRITISH SALT WATER FISHES

Specially painted for this work

A wide variety of fish is found in the [illegible] and some of them provide a welcome addition to our food supplies whilst others offer good sport to the sea angler. Fish are great travellers and some of them like certain birds migrate to warmer climates when winter comes. In this Plate are shown six well known British sea water fishes: (19) Large Spotted Dogfish, (20) Red Mullet, (21) Mackerel, (22) John Dory, (23) Plaice, (24) Conger Eel.

ALONG A SOUTH-COAST BEACH

Sea angling differs in many ways from freshwater fishing, and there is possibly more variety in the methods used to tempt the saltwater fish to take the bait. Here we see two anglers on the sea shore casting their lines far out in the hope of a responsive tug to indicate that a fish has taken the bait and the thrill of landing a good catch is in store.

for bottom fishing as well as for pollack, mackerel and other flat fish caught near the surface.

A dressed waterproof line about 100 feet in length and made of gut substitute or gimp is generally suitable though a fine silk line has been found best for a few fish. Among the fish to be caught off the British coast are Bass, Cod, Conger, Mackerel, Dab, Flounder, Plaice and Skate. Then there are Pollack and Coalfish, both members of the Cod family usually found in rocky waters, while other members of the Cod family include Whiting, Pouting, Haddock and Hake. The baits in general use are shrimps, mussels, crabs and various shellfish, lug and ragworms.

Grey Mullet is in its own class and the angler needs fine tackle and small hooks for this highly-prized fish. It can be understood that where there is such a variety of fish this question of tackle is a wide one. Often enough the paternoster and the leger are used. These curiously-named pieces of tackle are really a form of double or triple hooks. The paternoster is a long trace of gut or gimp to be attached to the line and with three "booms" of stiff wire; a lead is at the bottom. The leger is usually so arranged that while the lead rests on the bottom the gut carries on beyond it and it is very useful in a strong tide and with the fish feeding just off the bottom.

Advice from the Old Hands

On rocky shores fishing can be done from the rocks, just as it can be done from a pier or jetty, but often it is better to go out in a boat a mile or more from the coast. As in all forms

of angling the beginner will be wise to seek advice from one on the spot or from an angler who has had a fairly wide experience and knows what to expect on that particular stretch of the coast.

Obviously it is important to know what kind of fish can be taken in that part of the coast, what kind of bait has proved most profitable, the signs and portents which show that fish are there to be taken, and a good many lesser points which experience has brought forth. A knowledge of these may make all the difference between a dull wasted day and an exciting few hours of sport which will live in the memory.

There is one form of angling which the Americans have made popular in comparatively recent years and has now spread to other continents, and that is Big Game Fishing. The sport has also become very popular off the coast of New South Wales, Australia. In Britain, Tunny has been the principal quarry, and off the Yorkshire coast in the neighbourhood of Scarborough has so far been the principal battle-ground. Fish weighing over 800 lb. have been caught here. It need scarcely be said that in this kind of fishing both angler and tackle must be strong enough to stand the strains on both when a huge fish finds itself on a hook at the end of a line.

But this kind of fishing, while having its own fascination as well as its exciting highlights, is scarcely the soothing, peaceful pastime of which Izaak Walton and a long line of enthusiasts through the years since his day have written their lyrical praises. It is the man or boy sitting by some quiet stream who captures his roach weighing a pound, or the fly-fisher casting his line over the waters of the Test or some other pleasant river far from the noise and bustle of the town, to whom the charm, the fascination and the joyous thrills of angling most surely come.

"We sit on cowslip banks, hear the birds sing, and possess ourselves in as much quietness as those silent silver streams which we now see glide so quietly by us," wrote old Izaak three centuries ago, and a writer of to-day, A. F. M. MacMahon, has summed it up in this way: "If you become one of us you will find that it is not only a hobby: it is a philosophy of life that may help you to find in yourself that happiness which, however hard to find there, cannot be found anywhere else."

MAKING THE MOST OF YOUR CAMERA

THE VILLAGE BLACKSMITH

Here is an interesting photographic subject typical of the many to be found in village life. It is a good picture, too, whose composition emphasises the main interest, the Blacksmith himself. A better picture might have been obtained, however, with a less crowded foreground.

AND so you have a camera. If it is a box camera there is not a great deal for you to learn about the mechanical side of using it. The viewfinder shows you exactly how much of the scene in front of the camera will be shown on the photograph. The shutter may be provided with a lever to give either time or instantaneous exposure.

Points to Remember

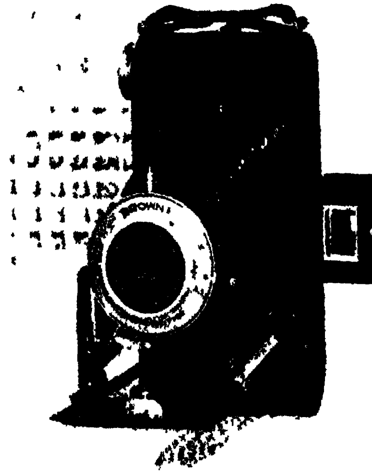
You must be careful when you use the time exposure to see that the shutter is closed when you have finished the exposure. Make a rule always to turn on to the next film immediately you have taken a picture. This will avoid your taking one photograph on top of another. For an instantaneous picture or snapshot it is important that the light should be good. Even with the sun shining, snapshots with a box camera are usually not very satisfactory if taken before about ten o'clock in the morning or after six o'clock in the evening. In winter it is better to confine your photography between the hours of eleven o'clock and four o'clock.

About Films

Another point to remember is that some types of film are much more sensitive to light than others. These films can be used for taking snapshots in light which would not be satisfactory for the ordinary roll film. Nowadays ordinary film is very seldom used.

There is a wide choice of films. The ordinary film, for instance, is said to be "slow," which means it gives the best results only with a comparatively long exposure. Thus, if it is to be used for "snapshots," the light should be quite strong. The colour red in the objects in your picture would, on such a film, come out black, and there would be very little to choose between the depths of the different colours on the negative. Nowadays a faster film is used, which is called orthochromatic, and this type is more sensitive to colour.

POPULAR MODERN CAMERAS

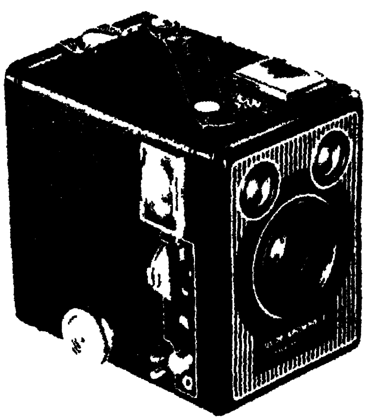


I. W. Kerr

The Voigtlander Brilliant is typical of the good inexpensive type of camera. It has a magnifying viewfinder and a lens which can be set to focus at approximately from 3 feet to infinity.

Kodak Ltd

This Six-20 Folding Brownie is a useful camera of the folding kind. Notice the optical direct vision viewfinder mounted on the camera body enabling the camera to be used at eye level.



Kodak Ltd

A box camera such as this Six-20 Brownie E for example, is ideal for beginners. It is not expensive and it is quite simple to operate.

Ensign

The Ensign Ful-Vue Camera shown here has a super viewfinder which gives an extra large preview almost the size of the finished print.

HOW TO STORE YOUR PICTURES

Kodak Ltd

This shows how the camera should be held. The sling strap, if there is one, should be round the neck, and the camera held against the body for steadiness.

J. Shaw

Mount your photographs in albums like those used by these young enthusiasts. Small and inexpensive gummed corner pieces, bought by the packet, hold the photographs in place.

Your negatives are worth keeping, and the best way to do this is to put them in transparent envelopes which will protect them from damage. The negatives should be filed and numbered, and the details entered on an index card. This gives you an easy and quick way of finding any negative you need.

Films of the panchromatic type are better still, and can be obtained in much faster grades than the others, giving good distinction between objects of different colours and being of such a fine grain that they are quite suitable for enlargements.

If You Have a Folding Camera

Your camera may, perhaps, be more elaborate than the simple box camera. In front of the lens you may find a plate marked F 32, F. 16, F. 11, F. 8, with a little pointer which can be moved on to any of these figures. The numbers 32, 16, 11 and 8 are called the stop numbers. When the pointer is moved on to a high stop number, such as F. 32, a diaphragm in front of the lens is closed down to make a very small aperture. When the pointer is moved to a low stop number, for instance, F. 8, the aperture in front of the lens is opened up to let more light in. The larger the aperture (that is, the lower the stop number) the shorter the time required to give a proper exposure under the same lighting conditions. It should be borne in mind that each successive smaller stop doubles the exposure required by the previous one; if a view taken at F. 11 requires an exposure of $\frac{1}{50}$ second, the same view at F. 16 would require $\frac{1}{25}$ second.

In the more expensive cameras the time of the exposure is controlled by means of another little pointer which can move over a scale which may be marked $\frac{1}{100}$, $\frac{1}{50}$, $\frac{1}{25}$ part of a second. But you may ask:

"Why is it necessary to have all this complication?"

There are several very good reasons. Supposing, for instance, you wished to photograph the finish of a race. With an exposure of $\frac{1}{25}$ of a second the picture would be blurred because the runners would have moved an appreci-

A. W Kerr.

THE WEDDING PICTURE THAT WAS NOT A SUCCESS

Everyone likes to take photographs at a family wedding. Weddings are exciting, and in this case the excitement seems to have spoilt the picture. Instead of gently pressing the release with the camera held firmly against his body, the photographer has jerked it, producing this disappointing picture.

SOME CAMERA FAULTS

There are three faults in this picture. Firstly, the beach ball is much sharper than the main figure of the little child, and this shows that the camera was focused incorrectly. Secondly, the camera was not held steadily when the photograph was taken. Thirdly, the background draws interest off the main figure.

[illegible]

Here the enterprising photographer has tried to get a new angle by climbing a high cliff and securing a splendid view point. But he has spoilt his picture by tilting his camera downwards, and this has caused both sea and coastline to run downhill out of the picture.

able distance during the time the shutter was open. So for a photograph of this kind you must use the shortest exposure available, say, $\frac{1}{100}$ of a second. Now, as the shutter is only open for $\frac{1}{100}$ of a second, the light has only had one quarter of the time to act on the film that it would have had if you had given a $\frac{1}{25}$ second exposure. To compensate, it is necessary to use a larger aperture which will allow four times as much light to enter the camera.

Now suppose on another occasion you wished to take a photograph of a building or some other object where it is necessary to obtain sharp detail from the nearest object in the foreground to the most distant object in the background of the photograph. A small aperture has the effect of sharpening up the picture. For such a photograph you would "stop down" the lens to F. 16 or F. 32. The small aperture would allow very little light to enter the camera and to compensate for this you must give longer exposure. You would set a timing pointer to its slowest speed, $\frac{1}{25}$ or perhaps $\frac{1}{10}$ of a second, if this speed is included in the range of your shutter.

For an exposure of more than $\frac{1}{25}$ of a second, however, it is necessary to hold the camera very steady, preferably having some support. With many photographers there is a tendency to jerk the camera slightly at the moment of using the shutter. For any time exposure, of course, a tripod or some solid support is absolutely essential.

Focusing

In addition to the adjustment for "time of exposure" and "aperture," most present-day folding cameras are provided with some form of focusing device.

The simple box camera has what is

SALISBURY CATHEDRAL

Our Cathedral cities are full of lovely camera subjects. Remember when photographing buildings to keep your camera upright. Tilting the camera will make the building also seem to tilt.

Photo: J. Shaw

A SALISBURY GATEWAY

This beautiful entrance to the Cathedral Close makes another fine camera subject. Interest is increased by the figures walking towards the gateway, but those to the right are a distraction.

A STUDY IN CLOUDS

Here is an excellent photograph of the Old Mill at Shirley in Surrey taken on a typical day of April. In this case, although a closer view point was possible, it was better to sacrifice the size of the mill and take the picture from a more distant spot. The young photographer should note the beautiful sky effect. This yields a decided pictorial improvement on a close-up of the mill only.

IN THE FARMYARD

Most photographs are better when taken with the light coming from behind the photographer, but on occasions a picture taken against the light will give very effective results. But remember to give a much longer exposure when photographing against the light than you would give when photographing with the light behind you.

known as a fixed focus, so that everything which is 10 feet or more away from the camera will appear in focus, although the focusing may not be quite as sharp as could be desired.

On folding cameras the distance between the lens and the film can be adjusted very slightly. This is done either by moving the lens holder forward or backward along the scale or by turning the ring in which the lens is mounted.

It is important when using a camera of this type to see that the focusing pointer is set correctly. For example, if you wish to take a close up portrait with the "sitter" 5 feet away from the camera the focusing adjustment must be moved to the 5 foot position and so on.

All the details mentioned above relate to the purely mechanical side of using a camera, but in order to obtain really good pictures it is necessary to know something about the principles of picture making or to use the technical term composition.

The Secret of Making Good Pictures

The first point to remember is that a camera lens is quite unbiased. It will record whatever objects come within its range. If you are taking a snapshot of your best friend on the beach your attention will probably be concentrated on the person. You may not have noticed a torn newspaper or tin can or perhaps some ugly railings which will destroy the artistic effect. But the camera will record everything impartially.

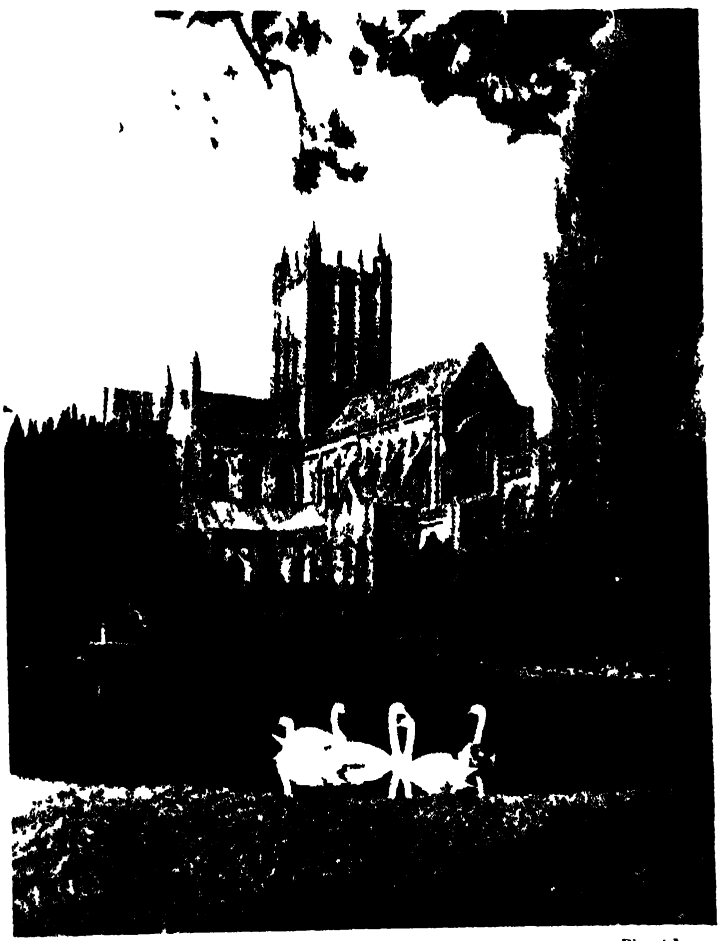
The first rule to remember, therefore, is to see that neither the foreground nor the background of the picture contain any objects which you would not like to see appearing in the finished print This is a very simple and obvious rule, but it is surprising how frequently it is overlooked by the beginner in photography

The next thing to remember is that every picture should have balance This does not mean that the main subject should always be in the centre of the picture, although frequently this arrangement can be made to give quite a pleasing effect, providing the rest of the picture does not throw the composition out of balance As a general rule it is better to have the main point of interest to the left or right of the centre with one or two subsidiary points of interest on the opposite side

One does not need to be an artist to realise how important it is to keep this question of composing the picture in mind before operating the shutter Then study the resulting pictures and you can soon acquire the art of producing really pleasing pictures whether your camera is a simple box camera or a very expensive folding camera provided with all the latest refinements

What to Photograph

Probably the first few rolls of film will be used in taking pictures of your friends These are an unfailing source of interest, but only to you and to the friends concerned You will soon arrive at a stage where you must look farther afield if you wish to extract the most satisfaction from the use of your camera which, after all is a wonderful instru-



Planet News

WELLS CATHEDRAL

This is a fine Cathedral study with great pictorial value The main interest centres on the Cathedral building and is not marred by the secondary interest of the swans on the lake in the foreground This is a picture that helps us to understand why Wells Cathedral has been called the most beautiful thing on earth

PHOTOGRAPHING ANIMAL FRIENDS

This delightful picture of a young spring lamb is the kind of animal study that is always pleasing, though sometimes it is very difficult to take because one's pet will not remain still for long

Photograph your dog but be careful to avoid queer angles which distort Such angles have been at work here making the dog's paws seem too large and out of proportion to its head

Cats will often persist in following the photographer closely around Kittens too move very suddenly and you will have to be quick to get a charming study like this

Photo H Armstrong Roberts

Most pets cannot be made to pose and successful pictures like this one of a rather forlorn wire haired terrier depend upon your being able to catch your pets in a quiet mood

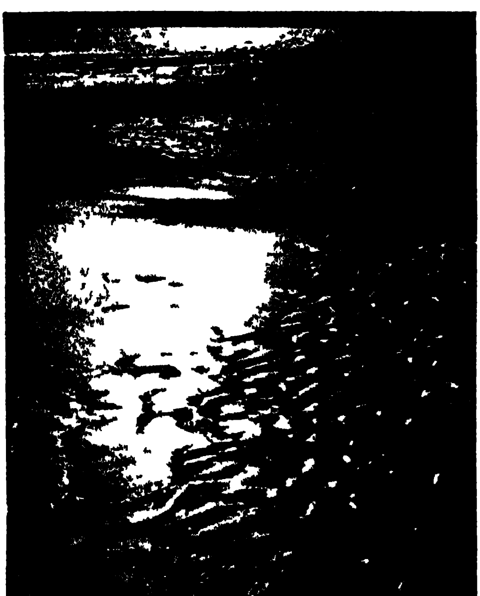
ON YOUR HOLIDAYS

H Armstrong Roberts

It's great fun taking a lovely picture like this of the family bathing in the sea but when you do take such pictures, take care to keep the salt water out of your camera

H Armstrong Roberts

Plenty of good pictures can be taken when the sea is calm and the sun is bright—especially if the photographer can wander into the sea after his subject



A W Kerr

At the seaside it is not always necessary to have the family in the picture Such simple things as a receding tide and sunlight on the wet sand make lovely studies

A W Kerr

Do not put your camera away when winter comes When the snow has freshly fallen the fields and lanes will present such lovely studies as this for the photographer.

ment capable of producing pictures which have a much wider interest than the purely personal.

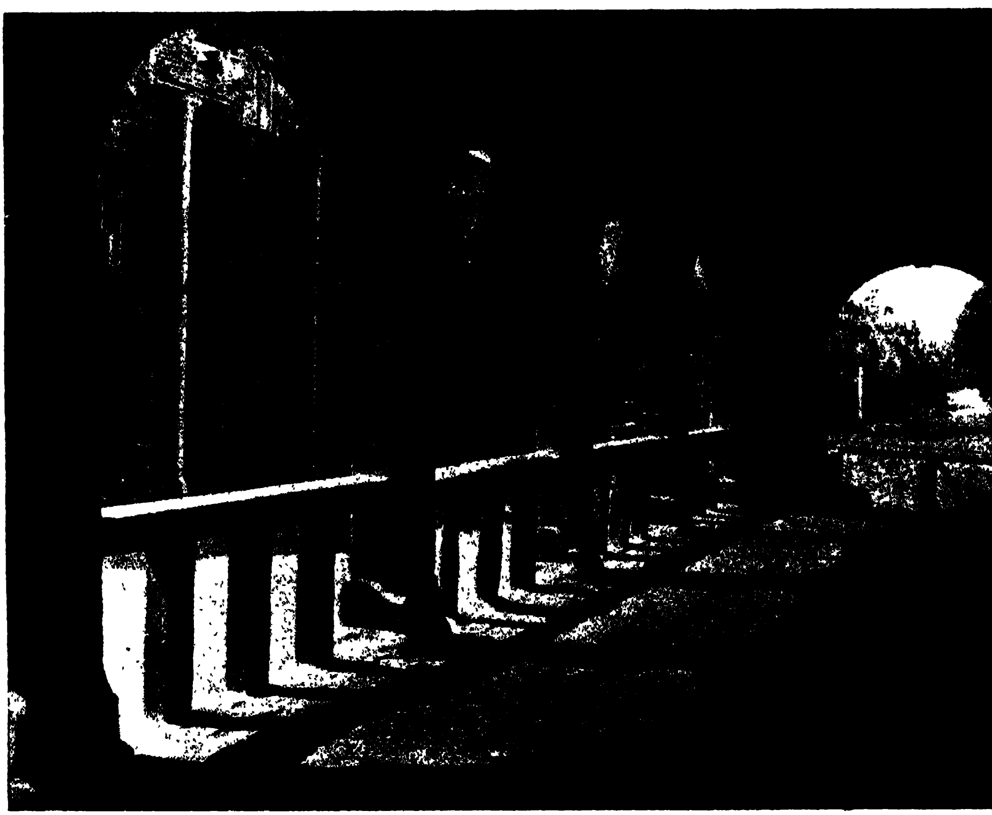
It is an excellent idea to specialise for a time in some particular type of photograph. For example, you might decide to take up the collection of a series of " Mother and Young " photographs, starting, perhaps, with a cat and her kittens. Next, perhaps, a hen and chicks, a duck and ducklings, horse and foal, cow and calf, ewe and lambs, and so on.

You will find that a series of pictures of this type will interest not only your friends, but if they have been carefully composed in accordance with the simple principles outlined above, they will provide really pleasing pictures to show to anyone who could only take a polite interest in the more intimate portraits of personal acquaintances.

Other subjects suitable for " series collecting " in this way are old churches, old inns, river scenes, unusual buildings, such as, windmills, oast houses and so on.

Try to make every photograph you take a picture, following the simple rules of composition. In this way you will find that you will become more and more interested in the subject of photography instead of just using it for only two or three weeks during your holiday season.

Naturally, if you intend to make photography an all-the-year-round hobby, the question of expense becomes important and you will find it an economy to do your own developing and printing. It is worth while obtaining a good book to guide you in this.



Fox Photos.

THE MARKET PLACE AT CHIPPING CAMPDEN

Our old-world English villages have provided many photographers with lovely subjects. This beautiful photograph shows the village street framed in the arches of the old market hall. Sunlight and shadows playing on the cobbles help to make it a fine pictorial study.

GARDENING FOR GIRLS AND BOYS

Studio Ltd.

THE YOUNG ENTHUSIASTS

As a healthful and fascinating hobby, gardening provides splendid exercise in the fresh air and there is plenty of scope for using our brains as well as our limbs because planning in advance is most essential. In gardening ground has to be skilfully prepared prior to sowing, and our attention must then be given to thinning, hoeing, weeding and watering before we can obtain a reward.

GARDENING is one of the most healthful occupations, for it is carried out in the fresh air and the work itself forms splendid muscular exercise for our bodies. As for the planning of a garden, there is abundant scope for careful thought, for imagination and individual ideas, so that our brains as well as our limbs can play their part.

Though there are sunny gardens and shady ones, each suitable for special subjects, the best all-round plot for girls and boys is one where there is a goodly amount of sun all the day through, with no large trees to cast shade, trees the spreading branches of which would cause constant drip in wet weather and whose hungry roots would impoverish the soil. In other words, an ideal garden is an open piece of ground, and if it faces south or possesses a southerly aspect, as we should say, so much the better. If yours is a shady, tree-flanked garden, perhaps looking into the north or east, you can only grow shade-loving plants successfully and may soon find you are robbed of a great deal of interest.

About the Soil

We speak of the earth or mould of which a garden is formed as the soil, and there are many distinct varieties. Stiff, reddish earth we term clay and some of the most productive gardens are those on well-worked clay soil. A sticky, yellowish soil is known as marl, and this is not a good staple for gardening purposes. When fine earth, sand and stones (especially waterworn pebbles) are mixed, we speak of a gravel

Reginald A. Malby

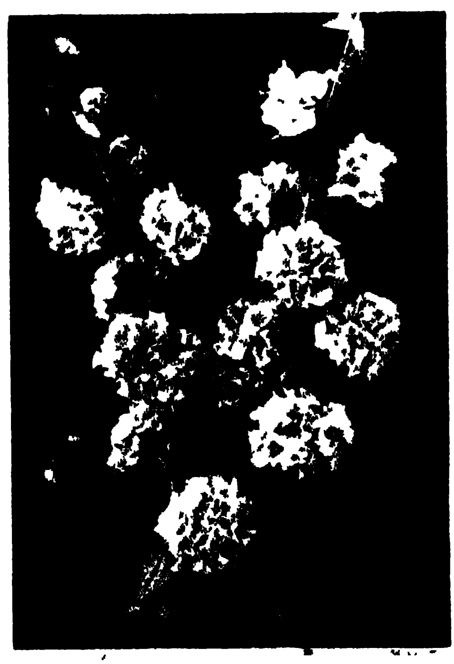
CANDYTUFT

A lovely hardy annual, 12 inches high. Blooms white, pink, purple, crimson, etc.

soil. Loam is a brownish soil, often charged with the fibres of decaying vegetation, and such fibrous loam is very suitable for flowers and vegetables. Sandy soil, as the name suggests, is a staple with a very large proportion of sand and you will at once understand that it dries out rapidly in hot weather. Chalk soil is light brown with bits of white chalk in it, being formed on the top of chalk rock. Peat soil is black, to a greater or lesser degree, apt to be very wet during the winter but excellent for an extensive range of plants that are peat-lovers.

You should get to know your soil because each type calls for slightly different treatment. Clay is good for roses, most of the vegetables and the majority of flowers. It needs deep digging in the autumn so that it may be thrown up in big unbroken clods for the frost to break down in wintry weather. Sifted ashes (especially bonfire and wood ashes), gritty sweepings from untarred roads and basic slag (to be bought from the garden stores) are all of benefit to clay. A gravel soil calls for decaying leaves and soft garden rubbish that has been rotted down in a compost heap or pit. Fibrous loam is improved by a little fine bone meal and some garden lime. Chalk soil is as a rule very thin, so that one cannot dig deeply, but it may gradually be improved if loam, leaves or material from the compost heap is added, hop manure also proving helpful.

Try to understand your soil so that you may know what to mix with it in order to obtain the best results. We speak of soil that has been well tended as being in good heart or perhaps in good tilth. It is from the soil that the roots of plants draw much of their nourishment, and you will never be very successful as a gardener unless you get your soil right before



C. W. Teager

CLARKIA

This grows about 2 feet in height: rose, scarlet, pink and white flowers.

CORNFLOWER

This hardy annual reaches a height of about 2 feet. Blue is the favourite, but there are pink and white varieties

undertaking sowing and planting operations.

A Gardener's Tools

It is not possible to manage a garden properly without workmanlike tools. These tools and appliances should be strong and well-made and they call for constant care. They ought never to be left out-of-doors after use, for exposure to both sun and rain will quickly spoil them. Before being put away, the blades of spades and hoes, the tines (sometimes wrongly called prongs) of digging forks and the teeth of rakes should be cleaned by rubbing them with a piece of wood, bright metal parts being afterwards wiped over with an oily rag. Have a place for every tool and see that each one is kept in its place, all ready to hand when it is wanted. Just occasionally wipe the wooden parts with a rag dipped in linseed oil. Most garden tools have handles and hafts made of ash; linseed oil in moderation preserves this wood and makes it softer to one's hands.

Now, let us consider the tools we shall require:

A SPADE is, first of all, a most useful tool for autumn digging, for making holes in the ground for planting shrubs, for trenching, cutting edges and so forth. Obtain a spade that is not too heavy for your age and strength.

A FORK is an essential tool for general digging, both in the vegetable plot and in the flower borders. The tines may be flat or rounded, the latter being the more easy to use.

A RAKE in general gardening is used chiefly for making the soil surface smooth, for gathering together weeds after hoeing, raking up heaps of leaves or stones and so forth. Such a tool

Blanche Henrey

HELICHRYSUM

A hardy annual bearing brightly coloured flowers like double daisies; height 3 feet. If stems are cut just before blossoms are fully open they may be dried for winter decoration

having eight or ten teeth will serve your purpose best.

HOES are of various kinds and they are all most serviceable tools. A Dutch hoe is used with quick, pushing movements as one steps backwards over the ground and its purpose is to break the soil surface and keep it loose and crumbly so that plant-life may flourish; and, of course, to destroy seedling weeds. A draw-hoe is generally swan-necked and is used for drawing drills or furrows in which to sow seeds; for breaking the top crust of hard soil; and for chopping off weeds. One 4-inch Dutch hoe and one 3-inch draw-hoe are all you need obtain. They should be strongly fixed to stout handles.

A TROWEL is invaluable for setting out small plants, for use when potting up seedlings and for many other purposes.

A HANDFORK with four short tines has many uses. It is valuable for breaking the soil surface round plants, especially tiny seedlings; for planting bulbs, for weeding in the rockery, and also for transplanting.

A GARDEN LINE is essential. It may consist of a length of stout string; or, better still, of fine cord made specially for the purpose. Most gardeners attach one end of their line to a metal peg and the other to a reel with spike, but you can manage quite well with two pointed pieces of wood. You will want a line for forming a straight edge to a bed, border or lawn; for drawing even drills when sowing seeds, especially those of vegetables; for obtaining the correct course when planting out rows of seedlings, etc. Always wind up your line after use and store it in a dry place.

Getting the Garden Ready

We have already considered the fact that soils vary a good deal, so let us assume that you have been given a plot of ground for your very own and that you are going to get it ready, either for growing flowers and possibly a few vegetables. You may find that it has been neglected, so your first step must be to clear it entirely of weeds and unwanted plants.

In these days, when stable manure is almost unobtainable, good gardeners rely largely upon decaying vegetable matter for fertilising their ground. Grassy and other green weeds; tops and tails and outside leaves of vegetables; lawn mowings; tree leaves and all such refuse are built up into small tight stacks in the form of compost heaps. When once decayed, this garbage forms humus, one of the most valuable of all plant foods.

Hoe off the weeds from your plot, therefore, and let them serve as the foundation of your own compost heap. Then, once the surface has been cleared, you may commence digging in earnest, but you should understand that for plants to flourish the digging must be done deeply so that the roots do not encounter hard subsoil as they thrust downwards.

Probably the best start will be made if, with a spade, you dig out a barrow-load of soil from the top left-hand corner of the plot and deposit it at the bottom right-hand corner. You can now commence digging on the left at the top, working the soil to the left and forward as you dig in an even line across the ground. Whether using spade or fork, thrust the tool straight downwards as far as it will go. If you insert the blade or tines in the ground on a slope they will not penetrate nearly so far as if they go straight down. Now lift the spadeful or forkful of earth and throw it upside down in front of you and to the left. For spring digging, clods may be broken down with spade or fork: but in the autumn the rougher the surface is left the better. Roots of coarse perennial weeds, such as those of docks, dandelions, stinging nettles, bindweed and ground elder should be picked out as you dig so that they may be dried off and burned on the bonfire.

SOME FLOWER GARDEN FAVOURITES

The Sweet Pea Queen of the Annuals is a climbing plant and reaches a height of 6 feet or more It does best when the ground is thoroughly trenched

Snapdragons are excellent border plants for massing and best treated as half hardy annuals Various heights and almost all colours Family name, Antirrhinum

The Forget-Me-Not is a perennial, but best treated as a biennial and sown every year Family name, Myosotis, or mouse's ear, from the shape of the leaves Height, 6 inches

Photos Reginald A Malby

Sweet Williams are biennials Seeds are sown in May or June, and the seedlings transplanted in September or October for blooming in the following summer Height, 18 inches

Let us say now that you have reached the end of the first row right across the plot. You will find in front of you a kind of little trench, and in this you may (with a fork) spread some stable or hop manure, if available ; or a small quantity of the material from a thoroughly rotted compost heap. Proceed next with the digging of the second strip and so on until you have completed the task, when that barrow-load of soil you first dug out will help you to level off correctly. Do not hurry digging. Be sure to take your time and work methodically. At first the exercise may make you stiff, but the muscles will quickly become used to the calls made on them and then you will be neither stiff nor tired.

Planning a Flower Garden

Having dug over the plot deeply and well in order that sour soil underneath may be brought to the surface, sweetened by air and dried in the sun, we have next to decide what the garden is to contain and how its occupants shall be arranged for the best effect. The most satisfactory method is to take a piece of paper and set out a plan, more or less to scale, showing the actual area. Upon such a plan we can now write in notes of the subjects to be chosen and eventually draw up a list of plants or seeds required.

Reginald A. Malby

ANNUAL SUNFLOWER

Who does not know the tall single annual sunflower, which may attain to a height of 10 feet or even more? Helianthus is the family name and the variety "Russian Giant," with a big brazen face, is one of the largest

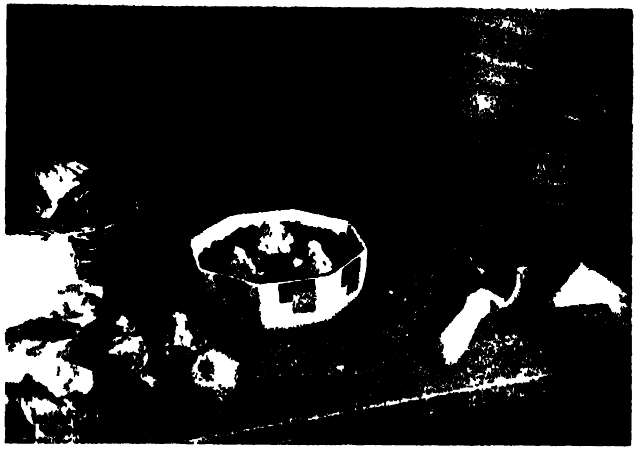
In the obtaining of a really effective floral border try to imagine for a moment that you are going to paint a picture, but that instead of using pigments you will depend upon bright flowers for the colours. Thus, you are sure to put your tallest subjects towards the rear to form an effective background. Plants a little less tall will be set next and then those of shorter stature until you come down to quite dwarf specimens well adapted to edging purposes.

So much for the planting of flowers of different heights. Bear in mind that plants coming near together should, so far as possible, blossom at the same time. In an autumn corner, for example, you may mass perennial sunflowers, rudbeckia, Michaelmas daisies, hardy border chrysanthemums and so forth.

The next point to consider is the correct arrangement of the plants ; and, generally speaking, it is best to form bold groups. Thus, a mass of golden marigolds is placed next to a cluster of blue cornflowers with a third group, perhaps of clarkias or candytuft, beyond. In any event, a draughtboard planting of single specimens dotted here and there is never so attractive as strong clumps. It is wiser, indeed, to grow only four, five or six of the best hardy annuals really effectively than to set a dozen sorts on such a small scale as to prove disappointing.

In this, your new little garden, you

may decide for the first season to grow nothing but annuals. Such plants are of annual duration, which means that seed is sown in the spring and the plants perish when they have produced their blooms. Seed of the annuals is obtainable everywhere in packets at very small cost and there is a particularly large choice of subjects, as the list below shows. To go further, there are two distinct types of annual, the hardy annual and the half hardy annual. The former is *h.a* in the lists and the latter *h.h a.* The difference between the types is that one is liable to be destroyed by frost whilst the other is perfectly hardy. Actually, with some types of hardy annual, such as cornflowers, godetias, love - in - a - mist (nigella), eschscholtzias (the Californian poppy), candytuft and Shirley poppies, seed may be sown in the open garden in September and the seedlings left in the ground all the winter through. As a broad rule, however, hardy annuals are sown in March.



Reginald A Malby

BULBS IN FIBRE

Often called "indoor gardening," it is very fascinating to grow bulbs in fibre in undrained bowls, prepared fibre being readily obtainable where bulbs are sold The miniature Roman hyacinth, daffodils and narcissi, scillas and crocuses are all excellent subjects for this interesting form of gardening

Growing Hardy Annuals

All the hardy annuals thrive in well-dug soil, but it is not advisable to make the surface too fine. When the earth is made unduly smooth by the use of a rake to excess, the top crust will bake very hard after heavy rain and then tiny seedlings cannot possibly get through. We must learn that the seed of hardy annuals varies a great deal in size, and deal with it accordingly, remembering that it is a good rule to cover seeds by two and a half times their height of soil. With big seeds like those of the nasturtium and annual sunflower we can make small holes with the sharp edge of a trowel at the proper distances and thus sowing becomes very easy. In the case of Shirley poppies we have seeds so small that they can hardly be singled out with a naked eye and they are best sown by mixing the seeds in a basin with many times their bulk of fine silver sand. The mixture may then be sprinkled thinly over the surface where the clump is to come and lightly covered with a little dry sifted soil you have laid by for the purpose.

Never forget that hardy annuals must be sown very thinly indeed. Again, when the tiny seedlings have appeared, they must be thinned out really hard. Most gardeners may attribute disappointment with these favourites to sowing too thickly and failing to thin promptly. Indeed, if each little plant has not a station to itself with sufficient space in which to develop overhead and to make a good root system it will not flourish. Further, the soil round the annuals ought always to have the surface kept loose and crumbly by use of the Dutch hoe,

all big weeds being pulled out by hand.

Always carry out the sowing on a warm day when there is no strong wind and the soil is dry enough for the rake to be used effectively. An hour or two after a shower, when the earth is moist enough to receive seeds but dry enough on top for sowing, is ideal. If you are to grow annuals in a straight line, peg down the garden line first. For really tiny seeds you can make a very shallow drill or furrow by drawing a stick over the earth just close up to the line. For a deeper drill, as for larger seeds, you may use the corner of a hoe. After sowing, cover your seeds with very fine soil. In some cases you may be able to rake fine soil into the drill, using the back of the rake and not the teeth. In other cases you can perhaps pick up a lump of earth in your hand

Reginald A. Malby

HYACINTH

Hyacinth bulbs growing merely in water in cupped glasses produce splendid spikes of bloom. If tap water is used, a piece of charcoal should be placed at the bottom of the glass.

and crumble it along the row over the seeds. Do not attempt to water the seeds immediately they have been sown, but wait for spring showers. If no gentle rain has fallen by the time the seedlings are up give them a little water by means of a can with a rose having very small holes.

Annuals and Perennials

Among the Hardy Annuals are Alyssum, Candytuft, Clarkia, Coreopsis, Cornflowers, Godetia, Gypsophila, Larkspur, Mignonette, Nasturtium, Nigella, Poppy, Scabious, Sunflower, Sweet Peas, Sweet Sultan and Virginian Stock. All the Hardy Annuals thrive in well-dug soil, but it is not advisable to make the soil too fine or it may become too hard when the sun shines after heavy rain. This forms a crust and the tiny seedlings cannot get through.

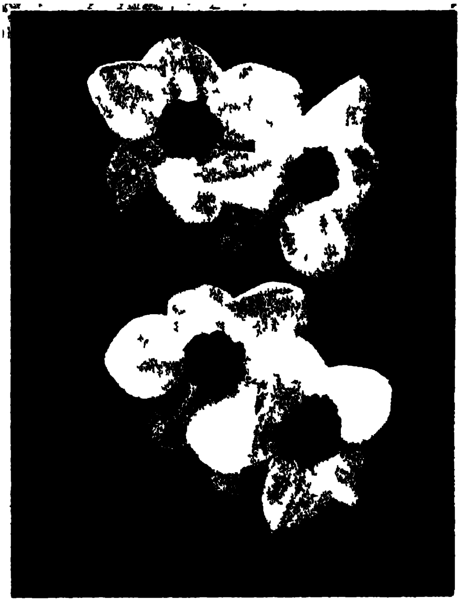
The Half-hardy Annuals are so-called because the flowers are quickly destroyed if frost touches them. This means that the seeds must generally be sown in boxes of light, sandy soil under glass in March; the seedlings are planted out about the last week in May, when, in most districts, there is little risk of further frost. In all other respects Half-hardy Annuals are treated in the same way as Hardy Annuals.

The Half-hardy Annuals include such flowers as Antirrhinum, Marigold, Petunia, Ten-week Stocks and Zinnias. Then there are the Biennials, the seeds of which are planted one year and the plants blossom about a year later. Most of the well-known biennials are Spring-flowering and include the Evening Primrose, Foxglove, Honesty, Sweet Williams and Wallflowers.

Plants which come up year after year and continue until their roots become worn out, are known as Perennials. Among these are Anchusa, Campanula, Delphinium, Hollyhock, Oriental Poppy and Polyanthus. There are also the tuberous Perennials, such as the Dahlia,

DAFFODILS AND NARCISSI

A good example of the star shaped, medium crowned narcissus This type is known as incomparabilis and the trumpets are usually prettily fluted



This is the polyanthus or bunch flowered narcissus which is admirably suited for culture in fibre in undrained bowls Many varieties have orange cups

Here is the giant-flowered trumpet daffodil "King Alfred" The trumpet is the colour of old gold with the mouth turned back and strikingly frilled

The variety here illustrated is "Killigrew," which has a bright yellow perianth and an orange red cup Grouped in the Star Narcissus class, it grows strongly

Iris, Lily of the Valley, Michaelmas Daisy and Pæony.

Spring-flowering Bulbs

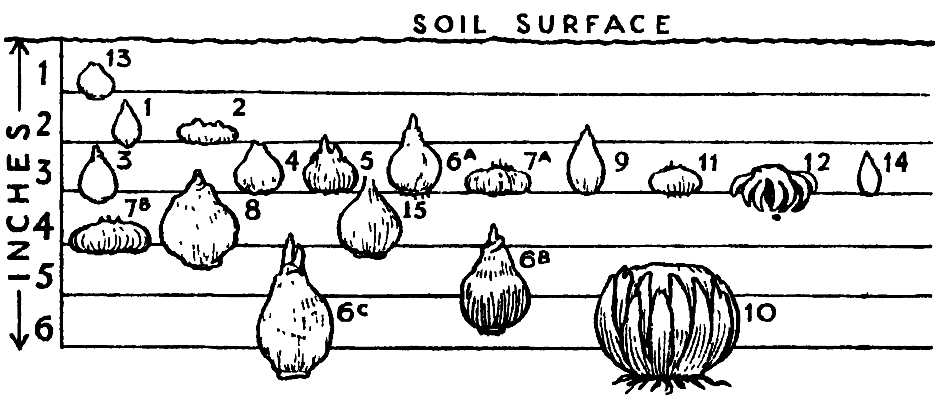
Some of the most beautiful flowers belong to the Spring-flowering bulb family. One of the most attractive ways of growing bulbs for decoration of the home is to plant them in fibre in ornamental bowls. The fibre, which should be well crumbled up before use and made moist, is usually bought already prepared with charcoal which keeps it sweet. The bowl is half filled with moist, lightly-pressed fibre, then the bulbs are placed in position on the fibre at such a depth that the tops are level with the bowl brim. The bulbs should be spaced so that there is sufficient space between each for another bulb of the same size. Then cover the bulbs with more fibre, pressing it down fairly firmly. Just the tip of the bulb should be left showing above the fibre.

The bowls are now placed in a dark, but well-ventilated cupboard for at least three weeks, and for some kinds of bulbs even up to eight weeks. The object of this dark room treatment is to ensure that the root system gets well started before the green shoots are allowed to develop.

When the right time comes, the bulbs are brought out into daylight. Care should be taken to ensure that the fibre is always kept nicely moist. Even when in the cupboard the bulbs should be inspected occasionally, and, if the fibre appears to be too dry, it should be gently watered and kept just damp. After the bowls are brought out, the conditions in the living-room are entirely congenial for the bulbs, but avoid draughts or positions too near the fire.

The best month for planting spring-flowering bulbs in the garden is October, but if necessary they may be planted even as late as December. The bulb family includes Anemone, Bluebell, Crocus, Daffodil, Hyacinth, Iris and Tulip

In the early years of your gardening hobby there will be little or no space in your small garden for vegetables. These will be a task for someone older, but it is in helping the older gardener that the beginner gains knowledge. In gardening, as in so many other worth-while hobbies, it is the enthusiast who is willing and anxious to learn from the experience of older followers of the craft who makes the best progress.



Specially drawn for this work

A GUIDE TO BULB PLANTING.

This diagram shows the approximate depths at which bulbs should be planted and here is the key 1, Aconite 2, Anemone 3, Bluebell 4, Chionodoxa 5, Crocus 6, Daffodil (a) small, (b) medium, and (c) large. 7, Gladiolus (a) small, (b) large. 8, Hyacinth 9, Bulbous iris. 10, Lilies. 11, Montbretia. 12, Ranunculus. 13, Scilla 14, Snowdrop. 15, Tulip

Favourite Hobbies: Pastimes at Home and Out of Doors

Collections: How to Begin—and Afterwards

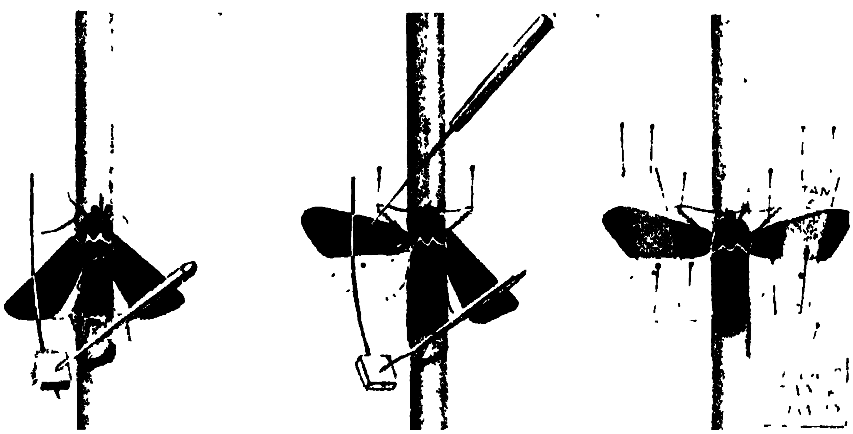


Photo and drawings specially prepared for this work by Bowne and Iris

SETTING A SPECIMEN

In this picture we are shown how to set a butterfly or moth. This is the needle and bristle method and, beginning at the left of the picture, we see the three steps in this simple little operation as described on p. 290

BUTTERFLIES AND MOTHS

THE collecting of butterflies and moths has the advantage of being very inexpensive except in personal effort, since one usually does not *buy* for one's collection and of being done mostly in the open air.

A Full-time Hobby

The catching of the nimbler varieties of butterflies entails a good deal of healthy and strenuous exercise, as any seasoned collector will agree. Between them, during the warmer months of the year, butterflies and moths offer plenty of scope for devoting time to the pursuit of them; since one may hunt butterflies all day in suitable weather and, when dusk falls, transfer one's attention to moths, which get up about the time when butterflies go to bed—most of them, that is to say. During the summer holidays the enthusiastic entomologist—to give the collector of insects his rather formidable scientific title—will find plenty of work for his waking hours, however long they be.

Leaving the great rarities, such as the Purple Emperor, Camberwell Beauty and Swallowtail, out of account, anyone who perseveres can make a fairly complete collection of British butterflies, the species of which are not very numerous. They include, however, many beautiful insects—who could deny the adjective to the Purple Hairstreak, Orange Tip, Clouded Yellow, Red Admiral, Peacock, the Fritillaries, and the Blues, for example?—and, when assembled in the store-box or cabinet, make a fine display of colour.

What moths lack in the matter of

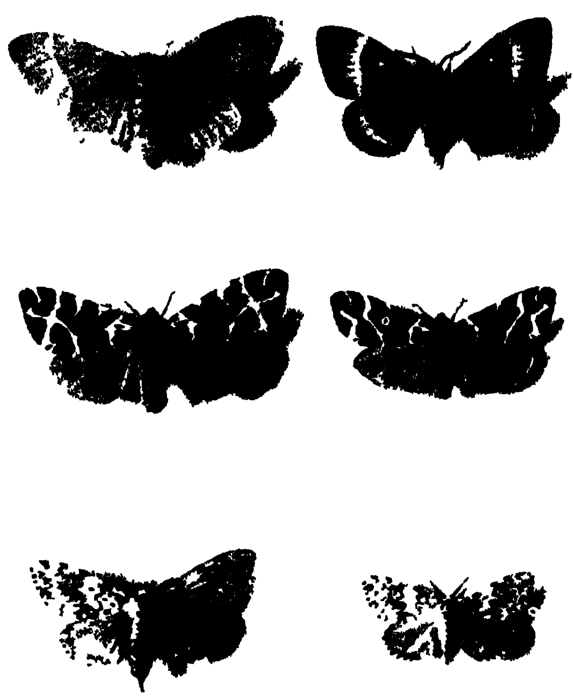
brilliant hues they more than atone for in variety, since British species number over 2,000. Not but what some of them—one thinks at once of the Tiger Moths, Burnets, and Underwings—are gay enough, and a great many very beautifully marked. No collector can expect to get together a complete collection of this order of insect; but by way of consolation the field is so large that there are always species still to be captured.

CATERPILLARS AND PUPÆ.—Collecting does not necessarily begin with the capture of the insect, which, after all, is in the third of the three stages of its existence. For the collector will always have an eye wide open for caterpillars, which may be caged and fed till they turn into pupæ or chrysalises; and for chrysalises also. If things go right, a chrysalis will in due course present its finder with a perfect insect, and repay him for any trouble taken in the getting and keeping of it.

The Collector's Equipment

First, of course, we put the ***net***, which should be shaped like a round-ended sack, and ***not*** like a jelly-bag, so that a "catch" may not be able to tuck itself away into a corner. The net can be made at home easily enough, out of a square yard of black gauze doubled and sewn up one of the long edges. One end is then rounded off to an arc of a circle, and stitched, while the other is hemmed firmly to a band of linen, doubled so as to form a tube for the ring of cane which keeps the mouth open. As for the ring itself, if a small extra expense can be faced, there is much to be said in favour of one subdivided into three pieces which fold or can be taken apart for packing into a small space.

Butterflies used to be killed by pinching their bodies sideways, but this is a very crude method and almost invariably damages the specimen. For moths a ***killing bottle*** has always been necessary, and it is best that butterflies should be dealt with in this way also. The killing bottle had better be bought from a dealer. A supply of ***glass-bottomed boxes*** of different sizes which "nest" into one another should be taken on an expedition for holding live specimens which later on, after examination, may prove not to be wanted. Then, one



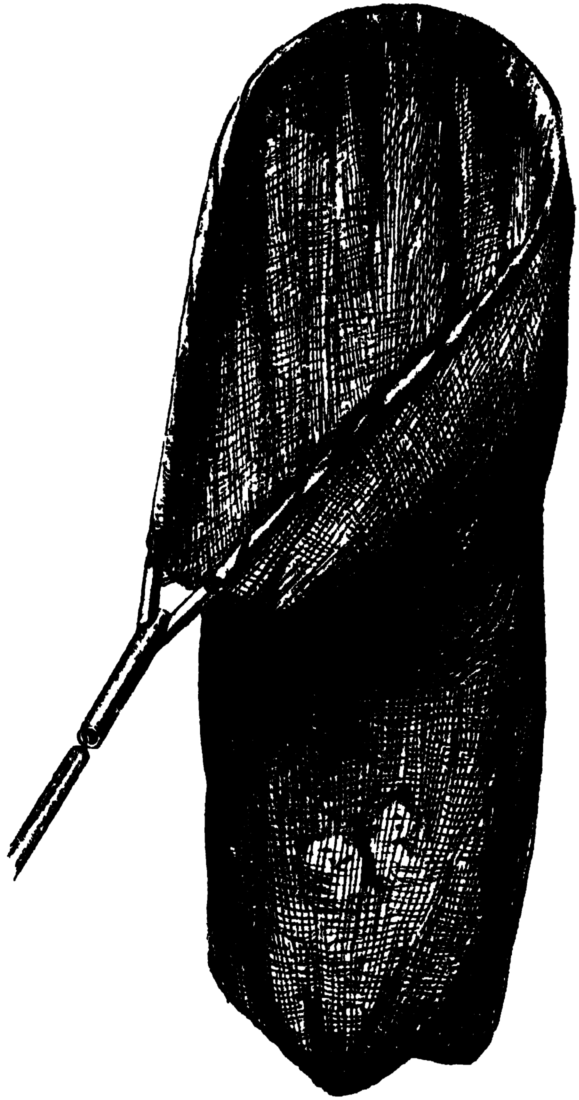
MOTHS TO TAKE BY ASSEMBLING

This photograph shows three species of moth, the males of which can be taken by assembling. The females are on the left and the males on the right. At the top is the Oak Eggar Moth, in the middle the Common Tiger Moth, and at the bottom the Black Arches Moth. From the collection of Ernest Aris, F.Z.S.

must carry a cork-bottomed *collecting box* in which to place killed insects after they have been "pinned," and in order that they may be pinned one must have with one a stock of special entomological *pins* of various sizes, coated with black enamel to prevent corrosion. The collecting box is lined with cork. This cork should be kept damp in order to prevent the insects from becoming stiff before the collector is ready to set them.

To hold all the items (except the net) named above and perhaps some food as well—the list must include a *haversack*, preferably one with a strap of a wide webbing, which will not gall the shoulder.

So much for the field equipment. There remain the articles needed for dealing with the insects brought home. The most important of these is a series of *setting boards*, either flat or round topped, with a central groove for the insect's body. Several sizes will be needed. The best are of cork mounted on a wooden base, which has extended ends to slide into grooves of a setting case like shelves. The handy boy can easily make a setting case for himself. It stands upright like a cupboard, and should have a closely fitting door, in which there may be an opening covered with wire gauze. The equivalent of grooves may be made by nailing to the sides pairs of slips $\frac{1}{16}$ inch thick, set the proper distance apart. It need hardly be said that all the setting boards to go into a case must be of the



THE NET

The above illustration shows the construction of the net. A four jointed cane is passed through the linen tube at the mouth of the net and its ends are inserted in the two arms of the Y-piece which is made of metal tubing. The handle is thrust into the base of the Y. Black gauze is best for the net, as it shows the captured insect clearly.

THE KILLING BOTTLE

This is an important item in the butterfly collector's equipment and the best plan is to buy one from the naturalist's shop. The one seen above contains a small quantity of cyanide of potassium covered with a layer of plaster of Paris which allows the fumes to come through and asphyxiate the insect. There are other types which have become increasingly popular in recent years.

same length. A setting case is a most useful thing as it prevents insects being damaged while on the boards.

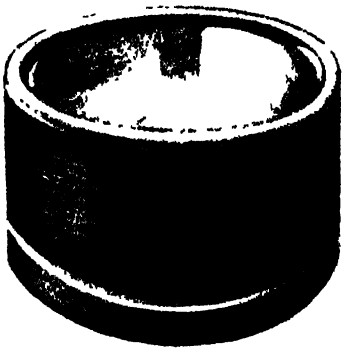
Store Boxes

These are for housing the collection in, and their number must, of course, increase with the size of the collection. They can be made cheaply out of soap or similar boxes, a number of which of the same kind and size should be obtained, if possible, at one time, to make sure of their matching. Choose only those in good condition, and as well made as such things are. Soak off any adhering paper and fix the lids on firmly with fine brads. Then round off all corners with sandpaper, to present as neat an appearance as possible.

A mark is now run round the box exactly half-way between top and bottom with a gauge. The box is then slit very carefully along the line with a fine tenon saw. The raw edges of the halves are now smoothed down, and the inside of what were the top and bottom lined with sheet cork—or better still, cork lino, if odd pieces can be got from an upholsterer—firmly glued down. Next, thin slips are glued on the inside of one half all round, reaching from the bottom to ⅜ or ½ inch above the top to make a lip round which the other half will fit snugly, and will be prevented from getting "out of register," while the box is rendered more or less dust-proof. The projecting edges are bevelled off slightly towards the inside to assist closing.

The last touches are to line the box inside with white paper, stain it or cover it with binding "cloth" outside, and fit hinges on one half, and hooks on the other. Of course, one cannot expect to turn out of such rough materials boxes which will compete in appearance with those sold by dealers, so before starting manufacture the collector might well consult a good catalogue and then decide whether to make or buy.

While on the subject of store-boxes, reference should be made to the importance of pinning into every one of them a piece of naphthalene, encased in paper well perforated with pinholes, to keep at bay the mites which attack set specimens if given the chance.



THE PILL BOX

Glass-topped pill boxes in various sizes are specially made for collectors of insects. They are useful when a collector wishes to examine a captive before deciding to kill it or let it go or when he intends to take an insect home alive for breeding.

Hunting and Catching

The catching of butterflies is largely a matter of luck, the proper district for local varieties, fine weather, agility and dexterity. To capture moths on the wing in darkness is obviously impossible. So the collector has recourse to the fatal attraction that light and "treacle" have for these insects. A strong light near an open window will bring in many moths when the weather conditions are right, and one can have quite good sport on occasions round the street lamps of a town. Then there are illuminated moth-traps, to which entry is easy while escape from them is difficult, for setting up in selected places.

Also, one may take with one a net and a strong acetylene bicycle lamp and beat hedges. The insects "put up," as a sportsman would say, may often be netted while flying in the beam thrown by the lamp.

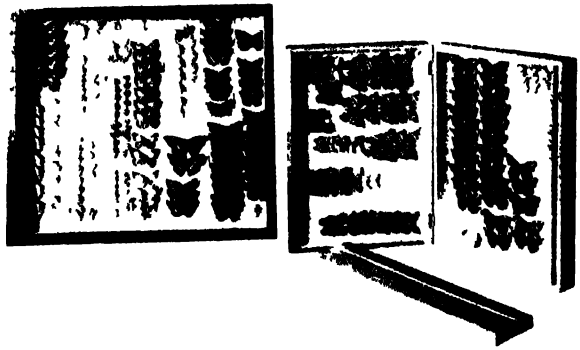
Another method is called "assembling." This is the best method for taking Oak Eggar, Tiger and Black Arches moths. A young female is enclosed in a lidless box, which is then covered with gauze and hung up on a branch or placed on a tree stump. The scent of the imprisoned moth will soon attract males of her own species from all quarters, and they can be caught as they flutter round the cage.

But the surest method of capturing many varieties is "sugaring" with a mixture of treacle and rum. Some collectors add a few drops of pear essence. Selecting a calm and warm evening, one smears the treacle with a

THE COLLECTING TIN

This is a tin box lined with cork. In it should always be carried a supply of assorted pins to suit various sizes of insect. The collector should be careful to keep the cork damp, otherwise his specimens will become rigid before he reaches home and he will then have all the trouble of relaxing them.

brush on the trunks and any easily reached branches of trees. The scent of the treacle attracts the moths as surely as the nectar of flowers, and the rum renders them—well, "incapable," so that they are easily boxed or transferred from their feast to the killing bottle. The light taken on one's rounds of inspection should be rather weak to avoid scaring the insects.



CABINET DRAWER, STORE-BOX AND SETTING BOARD

On the left is a drawer from a cabinet with various species of butterfly belonging to one family set out in series. On the right is a store box, which is so made that the insects can be displayed both above and below. The object in front is a setting board

Blossoming shrubs are good hunting grounds when moths are in search of an evening meal and the light just suffices to betray them. Pay special attention to lavender, pinks, roses, tobacco plants, phloxes, sweet williams and laurustinus.

WHERE THE COLLECTION IS KEPT

This is an upright cabinet containing a number of shallow, glass-covered drawers. These drawers are very carefully fitted into grooves

On Setting Moths and Butterflies

The "pinning" of an insect should be done carefully, through the centre of the thorax, the pin sloping slightly forward. The point should project sufficiently to allow the insect to clear the surface of the store-box easily when the pin is stuck well into the cork.

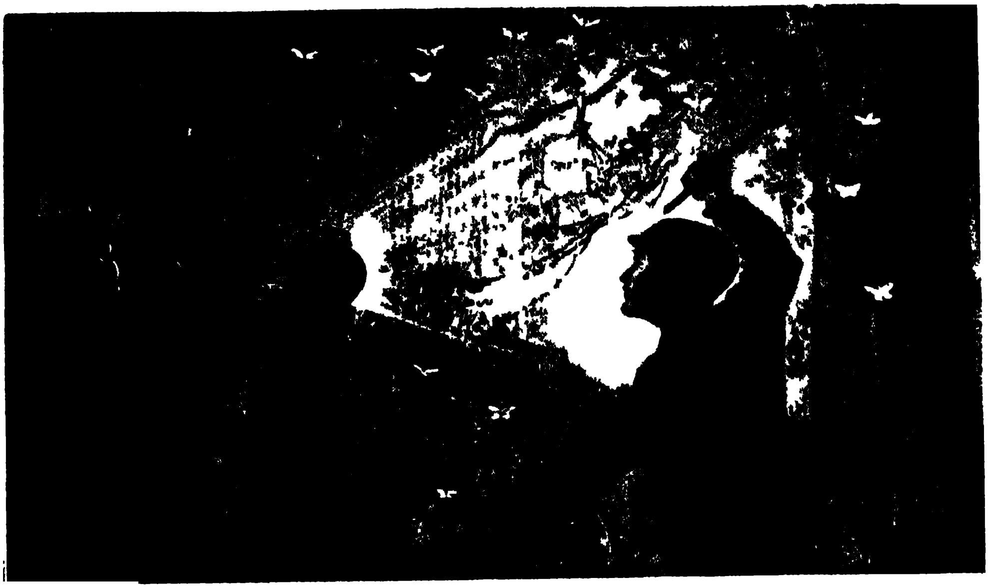
For setting, one needs a number of strips of paper, ¼ inch wide; and small triangles of thin card, each transfixed by a pin at the centre. A setting needle made by inserting the eye end of a large sewing needle into a wooden handle must also be provided.

We will assume that a butterfly has been placed on the setting board, its body well down in the groove. The wings are parted carefully, and one pair pressed against the board. The front wing is then drawn into position—its most forward point well in front of the head—with the needle and clipped in position by a triangle, the pin of

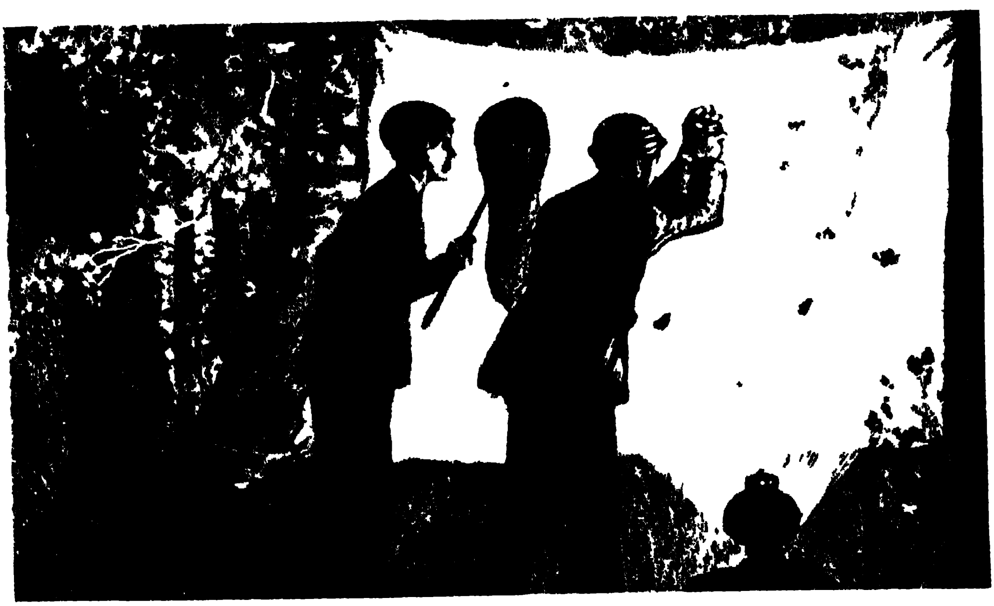
BEATING THE SALLOWS

When the sallows are in bloom many moths of various species resort to them after dark to sip the nectar of their flowers This juice is intoxicating and consequently when the branches are suddenly shaken or beaten with a stick the insects drop to the ground If, therefore, the collector spreads a large white sheet under the tree before beating it he will have no difficulty in finding the moths with the aid of his lamp The sallow is the Goat Willow ' tree

ASSEMBLING AND LIGHT

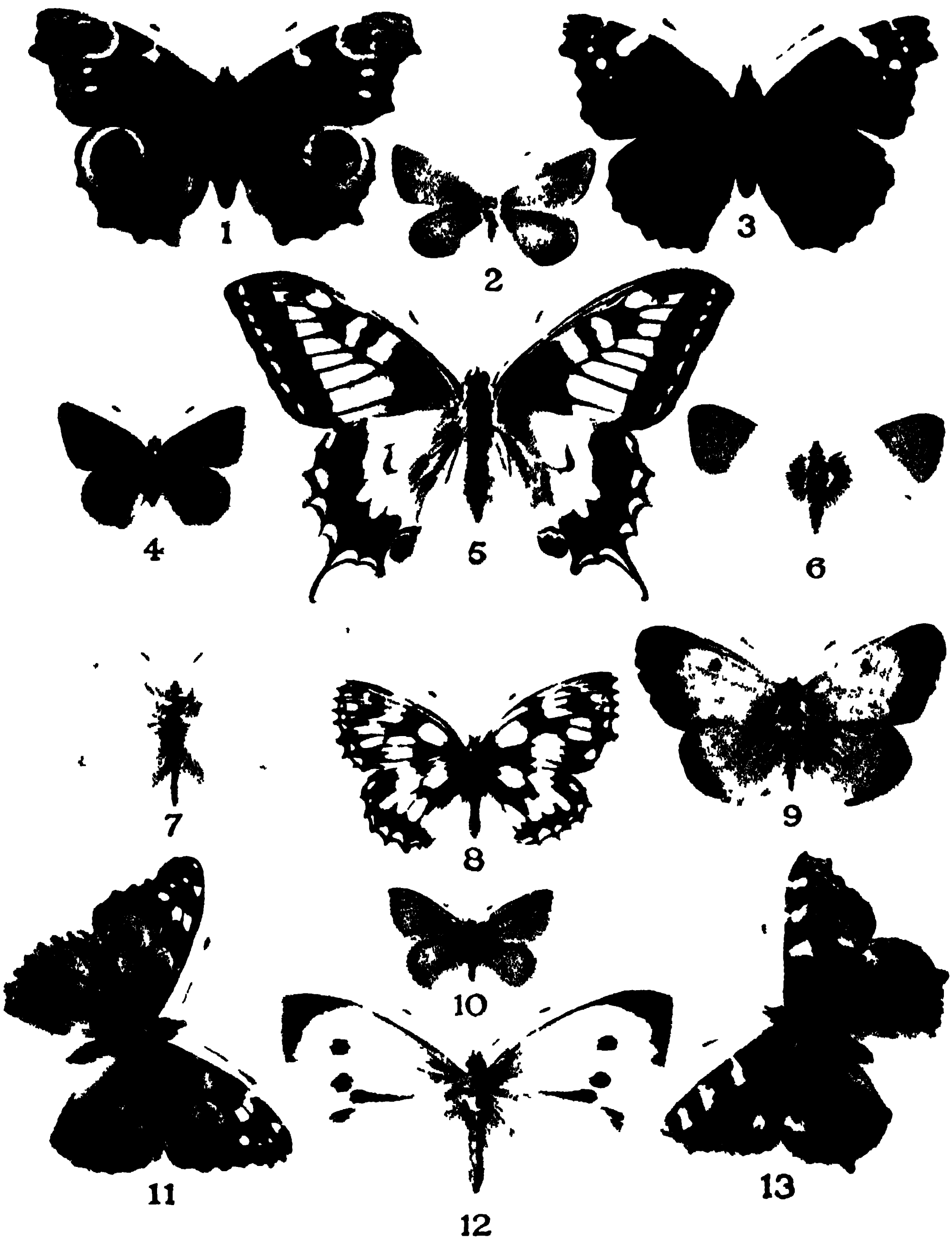


A newly hatched female is placed in a lidless box which is then covered with gauze. It is now taken to a locality in which its species is found and the cage is hung on a bough or placed on a tree stump. The males attracted by the scent of the decoy assemble in numbers and are netted as they come.



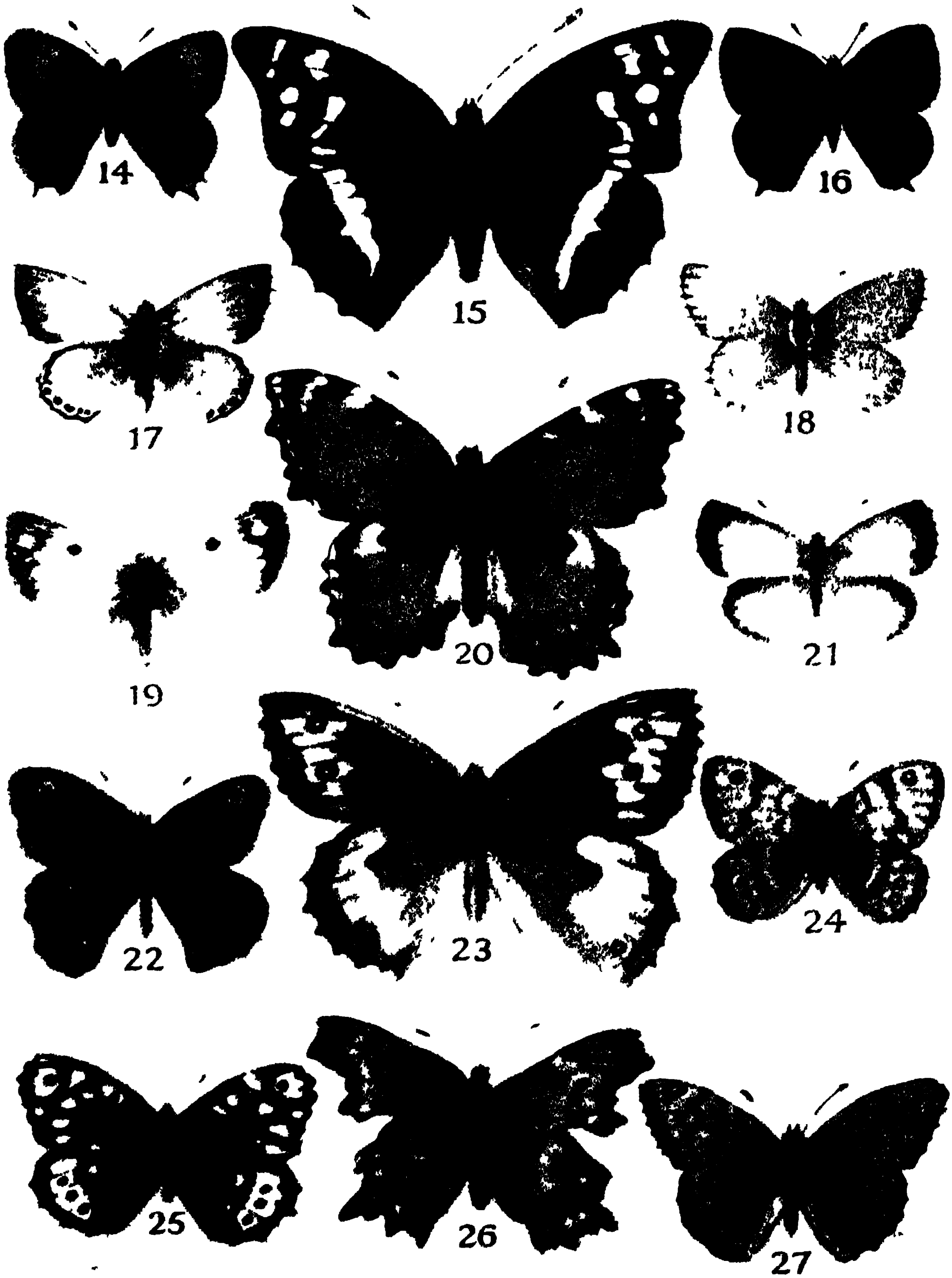
In a woodland glade a sheet is hung up between two trees and illuminated by the light of an acetylene bicycle lamp. The moths are attracted by the light and settle on the sheet. They can be either caught with the net as they fly about in the dazzling rays of the lamp or taken from the sheet in a killing bottle or a pill box.

BRITISH BUTTERFLIES—Plate 1



All the butterflies shown on this and the following plate are [illegible] When sex is given it indicates that male and female are of different colour [illegible] Common Blue [illegible] 3 Red Admiral 4 Small Copper [illegible] The Swallowtail [illegible] Orange-tip [illegible] The Brimstone [illegible] 8 Marbled White [illegible] Clouded Yellow [illegible] Small Heath [illegible] Painted Lady 12 Large White [illegible] 13 Small Tortoiseshell

BRITISH BUTTERFLIES—Plate 2



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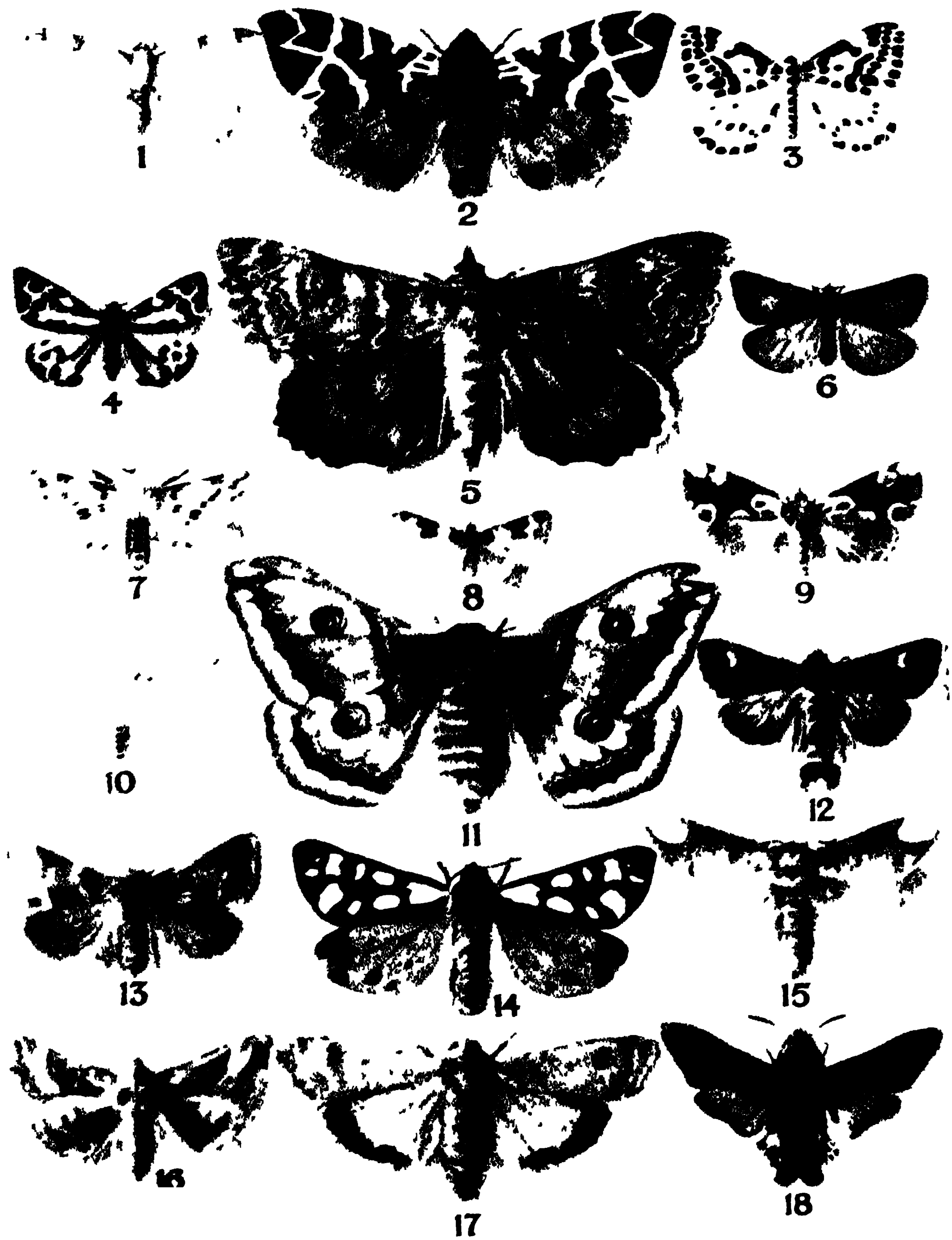
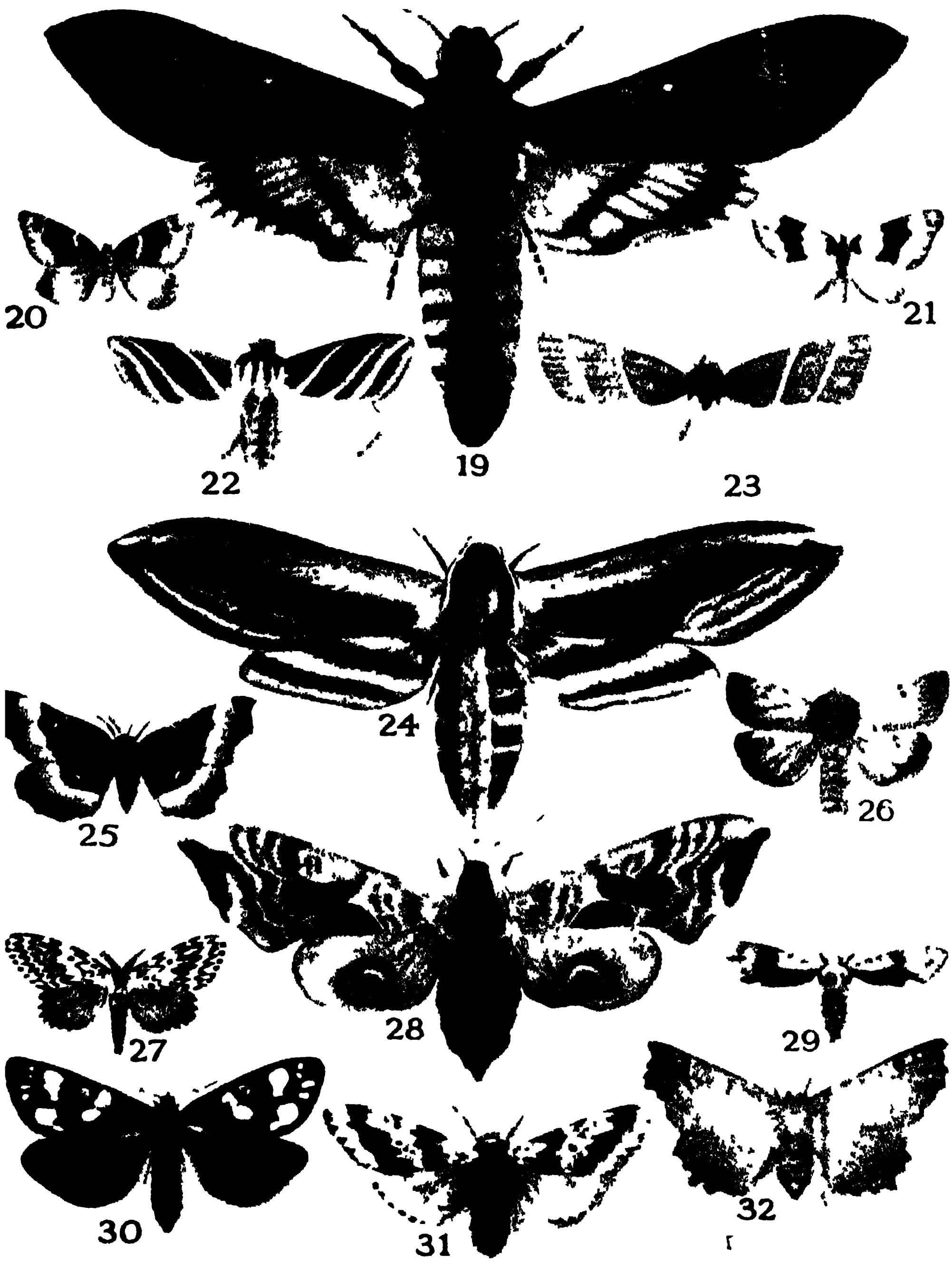
BRITISH MOTHS—Plate 1



BRITISH MOTHS—Plate 2



[illegible]

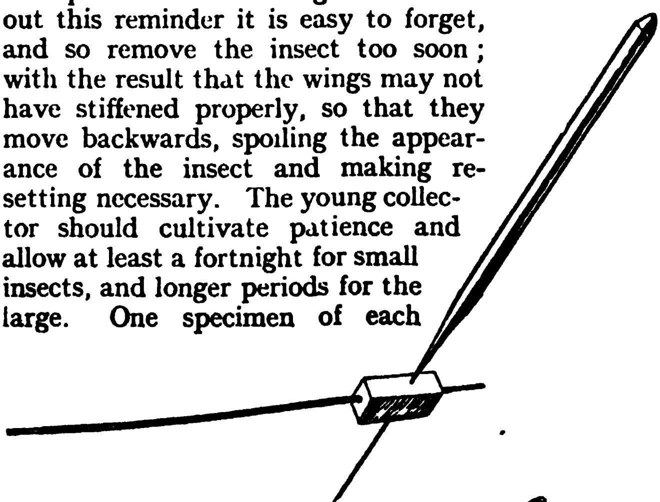
In this Plate a further fourteen British moths [illegible] When [illegible] indicates that there is a difference in the colouring of male and female. 19, Death's Head Hawk Moth, m; [illegible] Twin-spot Carpet, f; 21, The Purple Bar, f; [illegible] Silverline, m; [illegible] Scarce Silverline, m; [illegible] Privet Hawk, f; 25, Purple Thorn, f; [illegible] Tiger, m; [illegible] Black Arches, m; 28, Eyed Hawk, f; 29, Alder Moth, f; 30, Scarlet Tiger, f; 31, Oak Beauty, f; [illegible] Large Thorn, f.

"SUGARING" FOR MOTHS

About half an hour before dusk the collector walks through the wood with treacle pot and brush and paints a patch on the trunk of a tree here and there along the rides He then retires until darkness falls in order to give the moths time to sip enough of his bait to make them drowsy. **When he revisits the sugared trees it is easy for him to select specimens from among the feasting insects and to take them in killing bottle or pill box.**

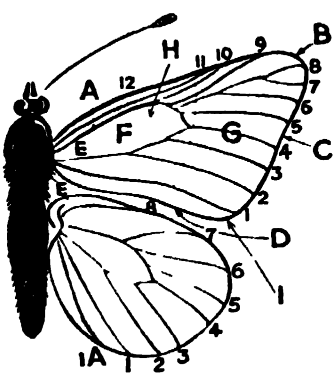
which is tilted slightly to press a corner of the card against the wing. The rear wing is then treated in like manner, its front edge being of course arranged under the rear of the front wing. Finally, a paper strip is laid across the outer edges of both wings and pinned down firmly at the ends. The triangles can then be removed, and the process repeated with the other pair of wings. Each antenna should now be fixed in its natural position by means of pins.

The last, and by no means least important, operation is to pin opposite the insect a scrap of paper bearing dates of capture and of setting. For without this reminder it is easy to forget, and so remove the insect too soon; with the result that the wings may not have stiffened properly, so that they move backwards, spoiling the appearance of the insect and making re-setting necessary. The young collector should cultivate patience and allow at least a fortnight for small insects, and longer periods for the large. One specimen of each species of butterfly should be set *upside down*, to show the under markings.



THE SETTING NEEDLE

This consists of a piece of cork, a bristle and a needle The cork is cut to form a cube The bristle is then passed through it lengthwise and it is pierced from side to side by a needle By this means the bristle can be kept in position across the wings of the insect by being pinned firmly to the board



WING VENATION OF A BUTTERFLY

When setting the wings of butterfly or moth, the point of the needle should be put under one of the veins The above diagram shows the various parts of the wings, as follows A costal margin, B apex, C outer margin, D inner margin, E base, F central shade, G outer shade, H discal cell, I inner angle, 1 A internal vein, 1 submedian vein, 2, 3, 4 median veins, 5 lower radial 6 upper radial, 7, 8, 9, 10, 11 subcostal veins, 12 costal nerve or vein

Another Method

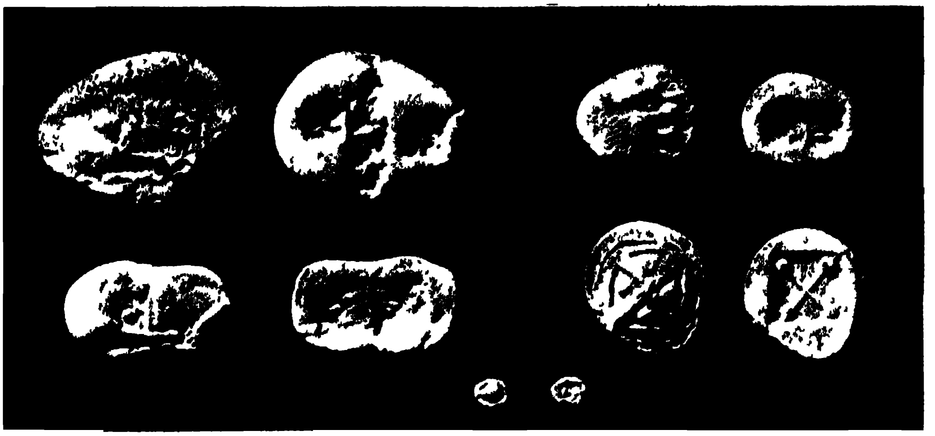
Another method of setting is shown in the picture on p. 281. In the first place the insect already pinned is taken from the collecting tin and placed in the groove of the setting board with wings lightly touching the surface of the board. The setting needle is then stuck in the board below it with the bristle resting on the wings as shown Next the legs and antennæ should be set. Then the point of another needle should be inserted under a vein of the fore wing. By this means the wing can be swung up into the desired position without danger of being torn. The pressure of the bristle will hold it there. The hind wing should then be treated in a similar manner

A piece of transparent paper should be placed over the two wings and pinned down securely. When this has been done, the bristle should be withdrawn and the wings on the other side dealt with similarly.

Relaxing

Any dead insects that have become stiff must be relaxed or softened before they are set. They should be stuck on a piece of cork, and placed in an airtight jar or tin containing a layer of damp sand. A few drops of carbolic acid on the sand will prevent mildew.

COINS: A FASCINATING HOBBY



GREEK COINS (*Slightly enlarged*)

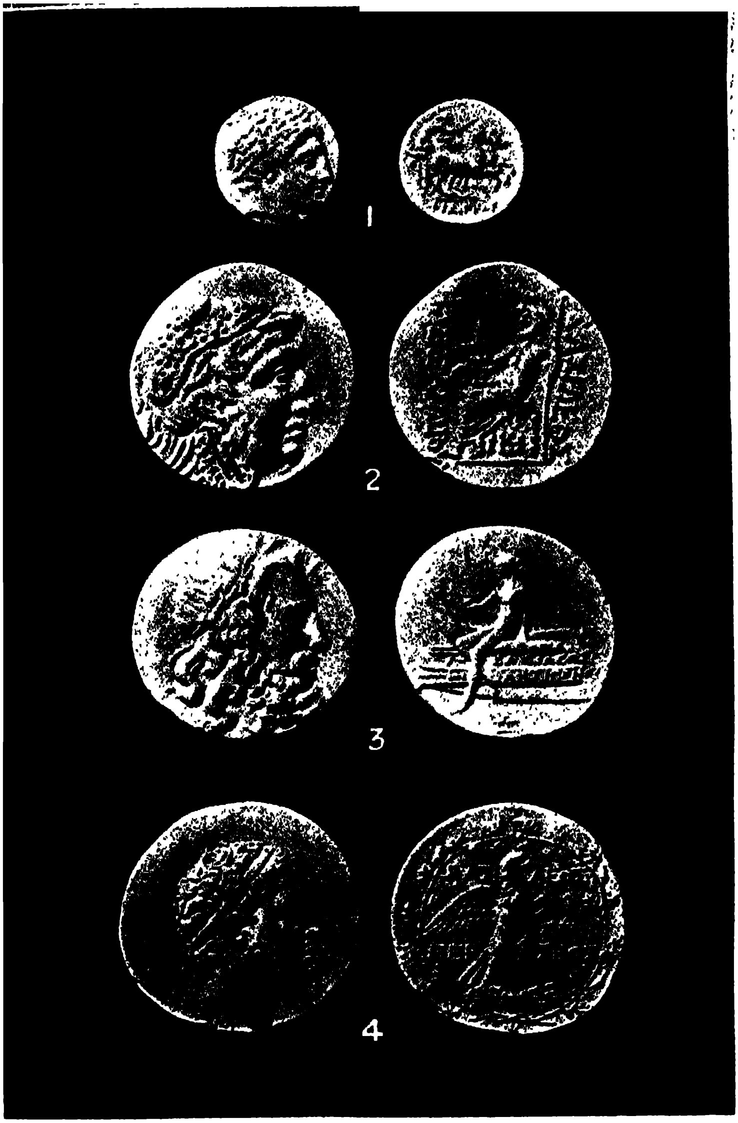
The illustration above shows some of the earliest known Greek coins from Lydia and Ionia. There are five coins depicted, the front and back of each coin being shown. Four of the coins are of a metal called electrum, an alloy of silver and gold. The fifth, in the bottom left-hand corner of the illustration, is of gold. Throughout this section the coins as represented vary slightly in size from their originals. This will be indicated in the captions, as above. The excellent illustrations are included by permission of Messrs. Methuen & Co. Ltd., from their book "Coins and How to Know Them," by Gertrude B. Rawlings.

THE science of coins, called numismatics, is one which may well appeal to the young collector. Coins have been used as a medium of exchange for the last 2,500 years at least. The earliest known were struck in the ancient kingdom of Lydia in the eighth century before Christ; and from that country the use of coinage spread rapidly over Asia Minor, the Aegean Islands and Greece, eventually reaching Rome, which became the centre from which it was carried into many parts of Europe. Whithersoever the power of Rome extended, along with it went Roman coins, which are now dug up in what were then the limits of the known world, telling the story, plainly enough, of Roman occupation. Similarly, Greek coins found in India and Central Asia speak of old-time traffic between those countries and Greece.

History in Metal

The earliest Greek coins were of electrum, a natural mixture of gold and silver found in the river sands of Asia. Later, the Romans used bronze, silver and gold for their coins, and their silver *denarius*, first used about 269 B.C., was for a long time the standard coin of the ancient world. Our own sign of "d" for pence in £ s. d. comes from this Roman *denarius*, just as one of the earliest English coins, the silver penny, was based on the Roman standard, and 240 silver pennies weighed one pound, again in imitation of the Roman *denarius*.

It has been said that a complete collection of coins is a history in brief of the civilised world. Certainly some of them are historical documents of great interest. Fig. 15, for example, shows a brass coin bearing on the obverse ("head") side the laurelled bust of the Emperor Vespasian, and the reverse ("tail") side the words "Judaea Capta," and a palm tree to which a Jew is shackled, while a weeping Jewess sits near him. This little piece of metal, celebrating the subjection of



GREEK COINS (Macedonia). (*Slight reduction.*)

The above illustration shows four Greek coins from Macedonia. Fig. 1 is a gold coin showing the head of the Greek god Apollo on one side, with a charioteer on the other, or reverse, as it is called. Figs. 2, 3 and 4 are coins of silver. Notice the very beautiful head in Fig. 3.

Judaea by Vaspasian in A.D. 69 and 70, shows literally the two sides of military conquest — triumph and misery.

Or, again, in a coin of the same period we have on the reverse a picture of the Colosseum, the huge amphitheatre at Rome begun by Vespasian and finished by his son Titus. How interesting, too, is a shilling (Fig. 29) of Queen Mary's reign, with busts of the English sovereign and her Spanish Consort facing one another; and on its reverse the combined arms of England and Spain. Cæsar speaks in his "Commentaries" of money being in use among the Britons. Some of these very early British coins, struck long before the arrival of the Romans, are evidently copies of the Macedonian *Stater* first minted in the fourth century B.C. Here, again, can be traced the effect of commerce. But how a design conceived in far-off Macedonia penetrated to (then) back-of-beyond Britain remains a mystery. It may have come by way of the Rhine, or by a more roundabout route through Spain and Gaul.

Coins and Romance

To very ancient coins belongs the further interest of their having been used by people who lived many hundreds of years ago — a couple of thousand, maybe. For all we know, this silver tetradrachm (Fig. 2) may have been handled by the Great Alexander, that Roman "aureus" (Figs. 10, 13, 14) have circulated in the household of Julius Cæsar; and this humble denarius (Figs 11 and 12) have rested in the wallet of a Roman Legionary Anyone blessed with a knowledge of history could weave many a little romance around the coins of his collection

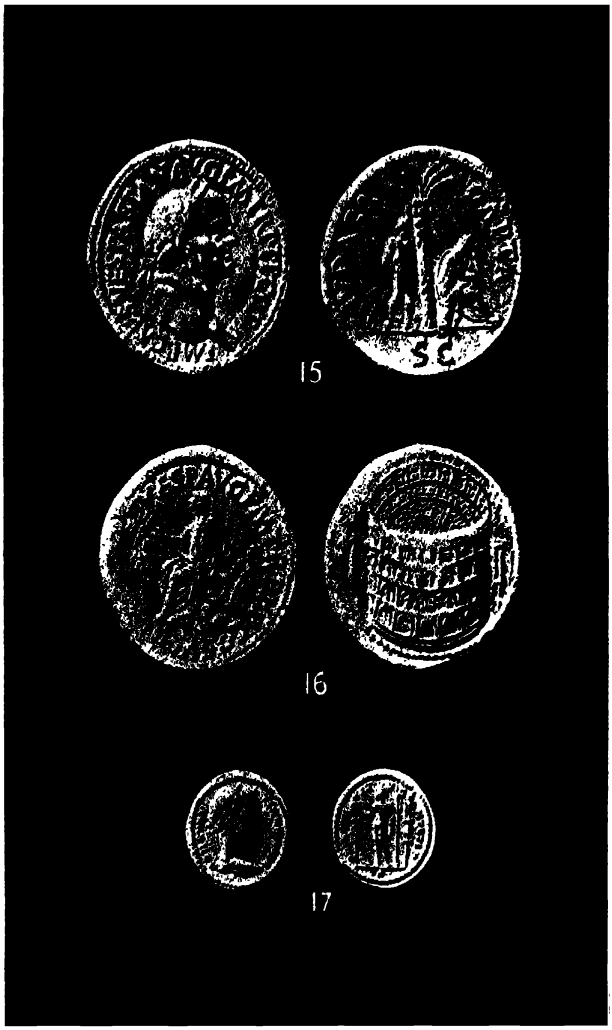
ROMAN COINS. (*Slight reduction*)
In this picture some Roman coins are shown Figs 10 and 13 are gold coins, the others being silver. The crocodile on the reverse of the coin in Fig 14 is interesting, as it refers to Rome's subjection of Egypt Fig 11 shows the head of the great Julius Cæsar To such impressions of Julius Cæsar's head on coins we owe our knowledge of his appearance.

In the third place, many coins are real works of art, with beautifully executed designs, notably those of the highly artistic ancient Greeks Others, at the opposite extreme, attract by the very crudity of their ornamentation. For example, a penny of Alfred's time, bearing merely AEL/FRED RE/X SAXO/NUM on one side, and EXA (Exeter, the place of minting) on the other (Fig 27).

In the Middle Ages

Between ancient and what may

be called modern coins come a whole host belonging to the Middle Ages, and of modern coins there is a bewildering array of the issues of all civilised countries. Every period and country has its particular treasures, after which the young collector may hopefully strive. Nor are the issues of to-day to be neglected. For a comparatively small sum a complete collection of the silver, nickel and copper issues now current in all countries of the world could be got together. It would at least familiarise the collector with foreign currencies and make quite a good display by itself.



ROMAN COINS OF A LATER DATE. (Slight reduction.)

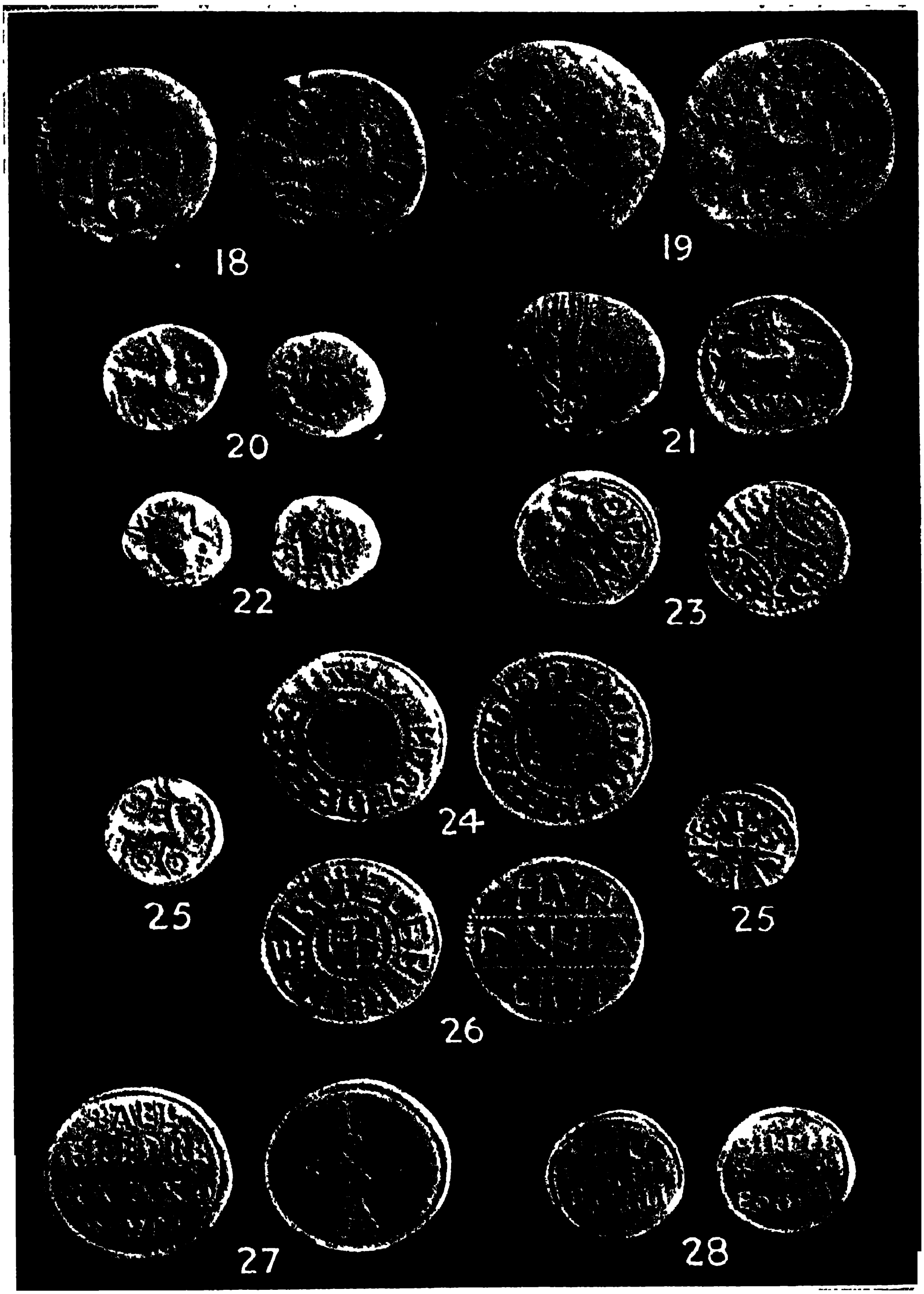
The illustration shows more Roman coins of a later date. Fig. 15 is of brass, Fig. 16 of bronze, and Fig. 17 of gold. The coin in Fig. 15 bears a fine head of the Emperor Vespasian, and the reverse of the coin shown in Fig. 16 is stamped with a picture of the Colosseum, the famous amphitheatre which the Romans used for the fights of the gladiators.

Hints on Collecting

Before one starts collecting in earnest, one should get to know as much as possible about coins generally, and the nature and history of varieties. The most valuable information and advice will be that of someone who has already amassed a good collection. Failing such help, or even where it is available, good books should be consulted.

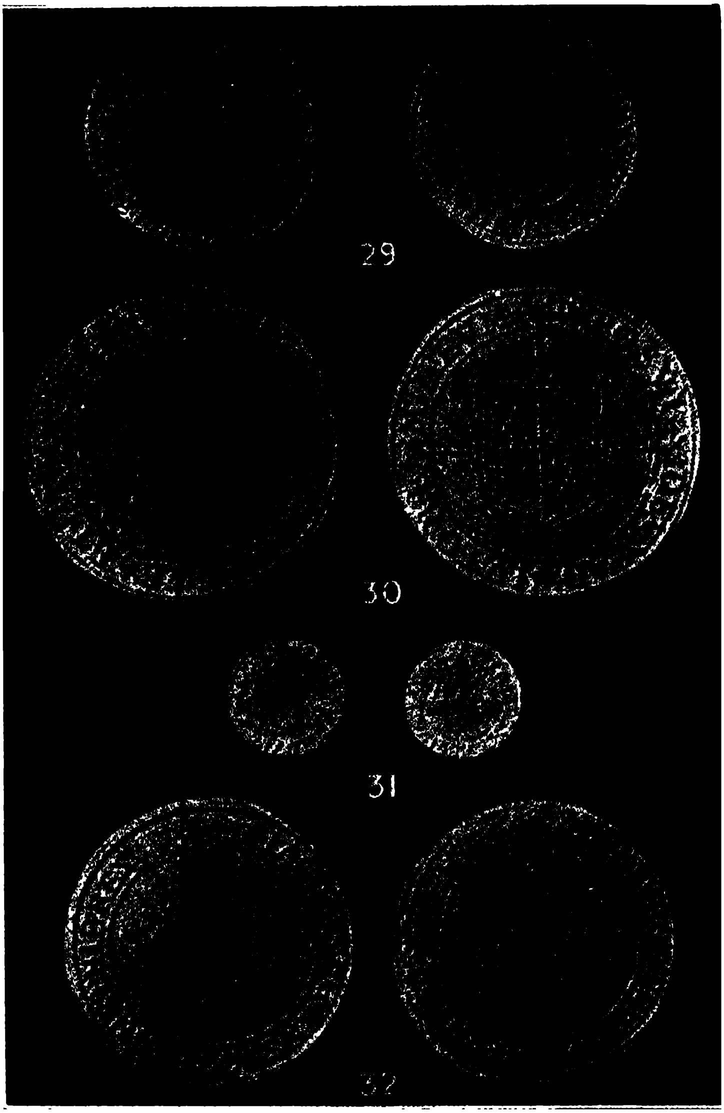
An excellent and inexpensive volume, which can heartily be recommended, is "Coins and How to Know Them," by Gertrude Burford Rawlings, containing concise letterpress descriptions of the coins of various coun-

GAULISH, BRITISH AND ENGLISH COINS



The illustration above shows a collection of coins (*slight enlargement*) from Ancient Britain Saxon England and Gaul, which was the old name for France Figs 18, 19 and 21 are gold, Fig 25 was struck from copper or base silver, the others are silver coins

tries, ancient and modern, besides many photographic illustrations. The following little books, issued by Swan Sonnenschein & Co., should also be looked for in second-hand bookshops: "Colonial Coins and Tokens," by D. F. Howarth; "Copper Coins of Europe," by Frank C. Higgins; and "English Coins and Tokens," by Ll. Jewitt and Barclay V. Head. All of them are extremely useful guides. In public libraries one can get access to, or perhaps even borrow, books of a more expensive kind.



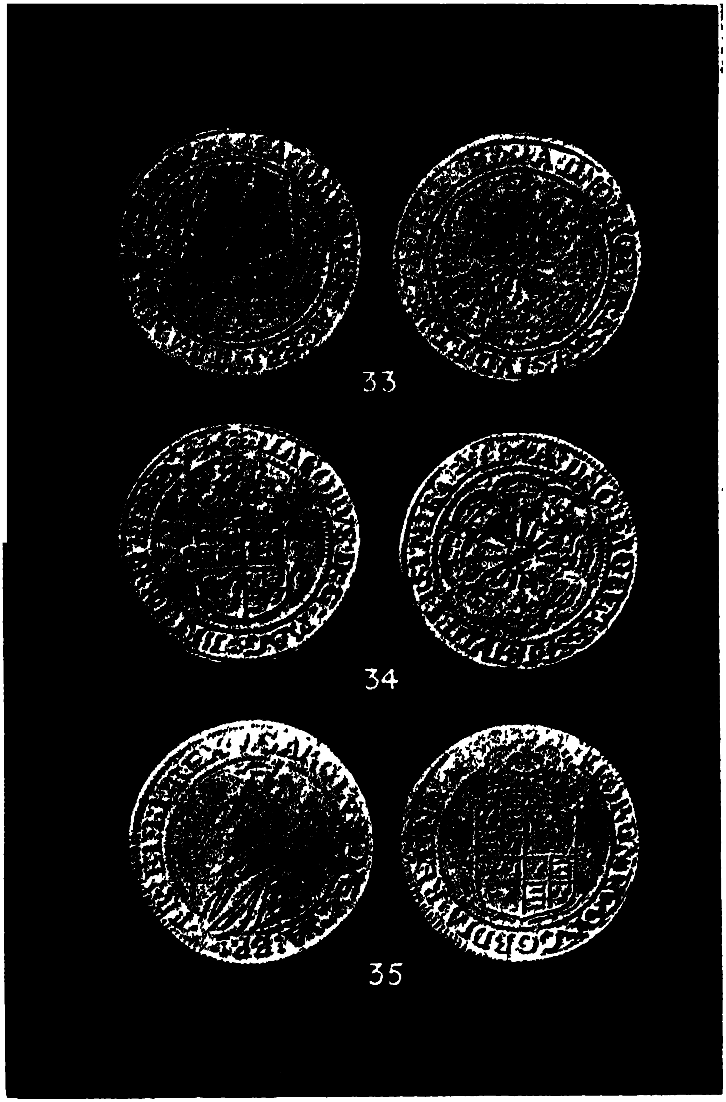
ENGLISH COINS. (*Very nearly actual size.*)

The coins shown here are of a much later date than those in the previous illustration. Fig. 29 shows a shilling; Fig. 30 a silver crown, which bears the head of Queen Elizabeth; Fig. 31 a gold quarter angel (an angel was a gold coin worth from 6*s*. 8*d*. to 10*s*.); Fig. 32 shows a sovereign of the time of James I.

When armed with a reasonable amount of knowledge, the collector will be in a better position to make use of any chances that offer. He should beware of odd coins displayed in the windows of small shops. The shopkeeper as likely as not knows little or nothing of their real value, and to be on the safe side asks much too high a figure. Also, a sharp lookout must be kept for "fakes," some of them very cleverly executed with the aid of electrotyping. Signs of age and wear are not to be taken necessarily as proof of genuineness, or fresh condition as one of lack of age; since carelessly stored coins

soon get the appearance of age, while well-cared-for coins will retain their freshness for centuries. In short, when purchasing, if one's own knowledge is not a sufficient guide, one should deal only with people who have a reputation at stake.

As with postage stamps, so with coins, the collector's aim should be to accumulate as many *perfect* specimens as possible. The worse should always give place to the better



ENGLISH GOLD COINS. (*Actual size.*)
This illustration shows three magnificent gold coins. Figs 33 and 34 were struck in the time of James I, Fig 35 in the time of Charles I.

Care of Coins

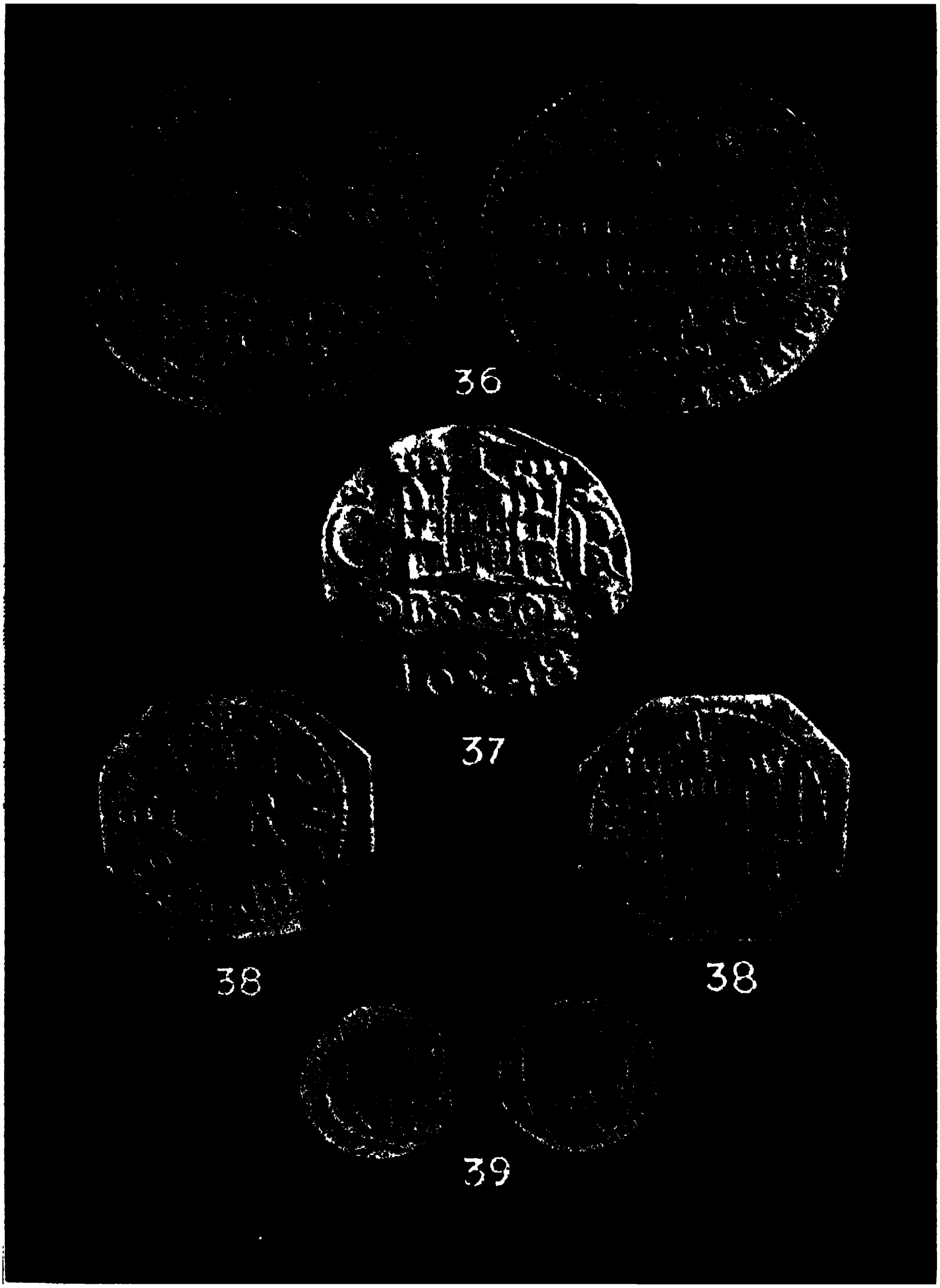
The treatment of old and dirty coins must be guided by the principle that old coins *are* old coins, and should not be made to look like anything else. One should remove any loose matter by steeping in a solution of washing soda, and brushing with an old tooth-brush until the design stands out clearly. But it is a great mistake to aim at brightness in old coins. The removal of the natural oxidised or tarnished surface may take with it a good deal of the value of the coin.

Mint-new coins must be handled very carefully to avoid staining them with the fingers. Lift them flatwise between finger and thumb, pressing on opposite points of the edge.

Storing a Collection

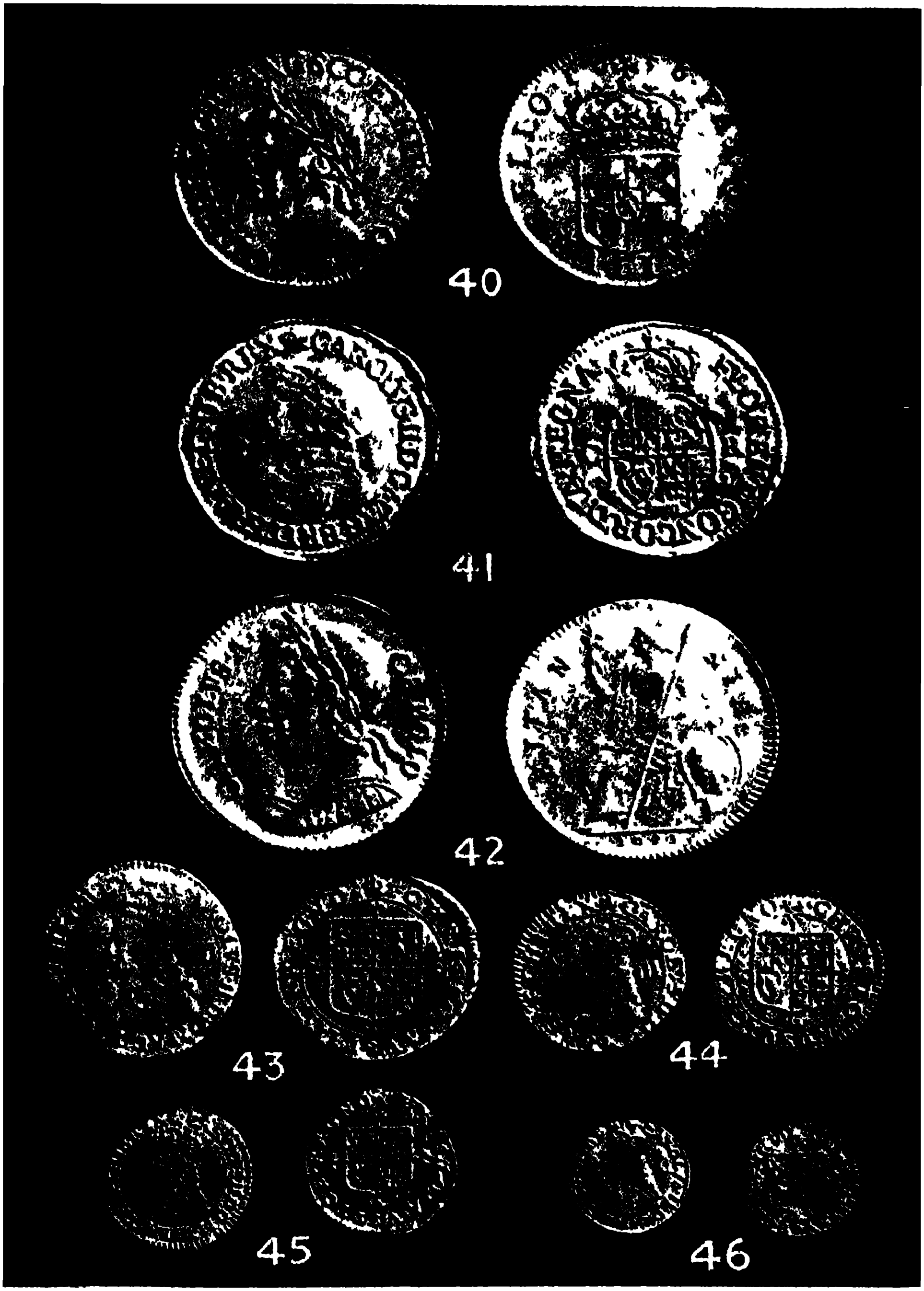
A collection should be kept in trays, housed in a lock-up cabinet.

A CROWN AND A GROAT



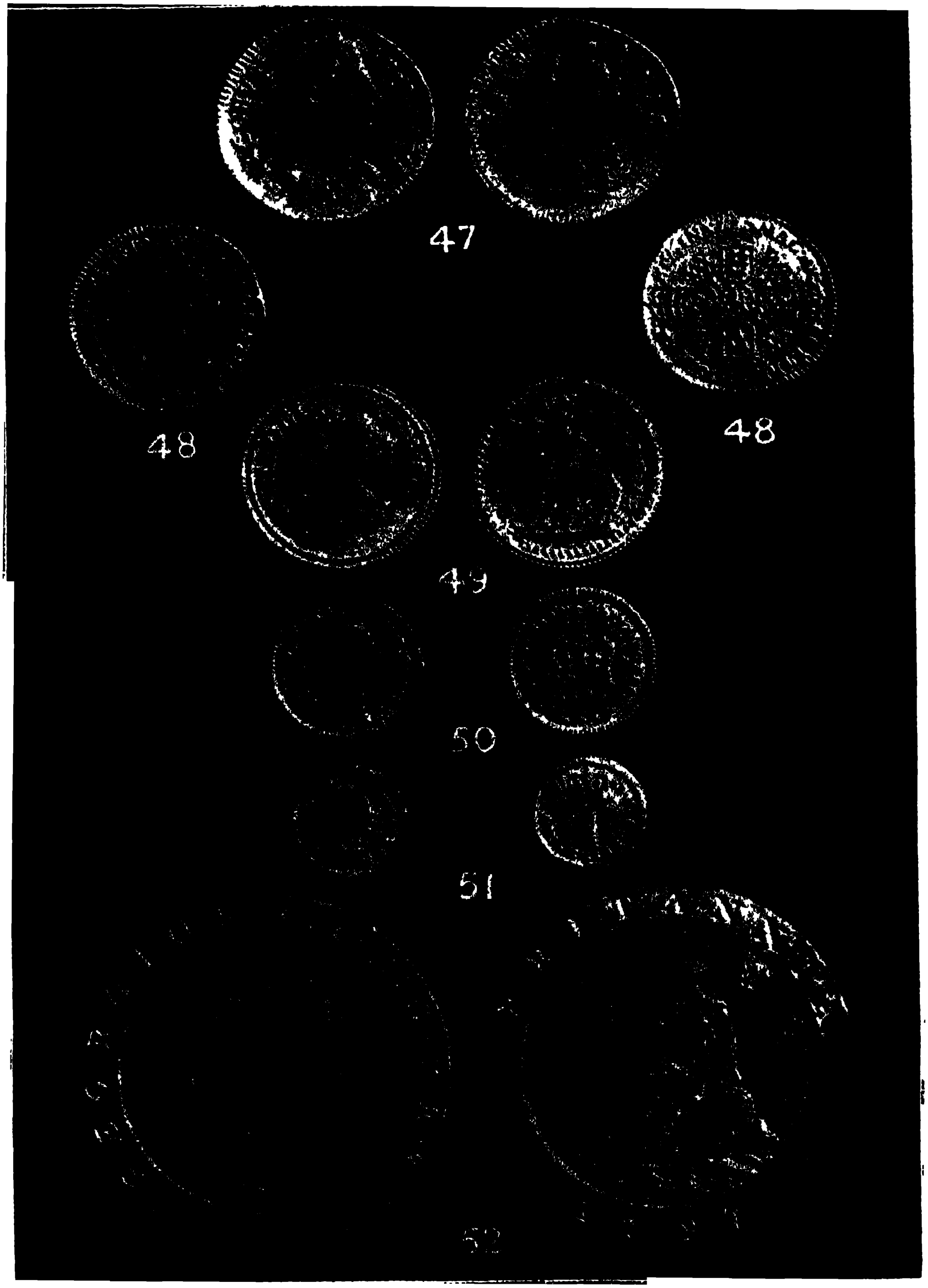
In this illustration the coin shown in Fig 37 is of gold, the rest being of silver Fig 36 depicts an Oxford Crown of the time of Charles I, Fig 37 shows a ten-shilling piece from Colchester, Fig 38, a Pontefract shilling, and Fig 39, a half groat of the time of the Commonwealth A groat was worth *4d* The coins shown here are slightly enlarged

ENGLISH COINS: CHARLES II.



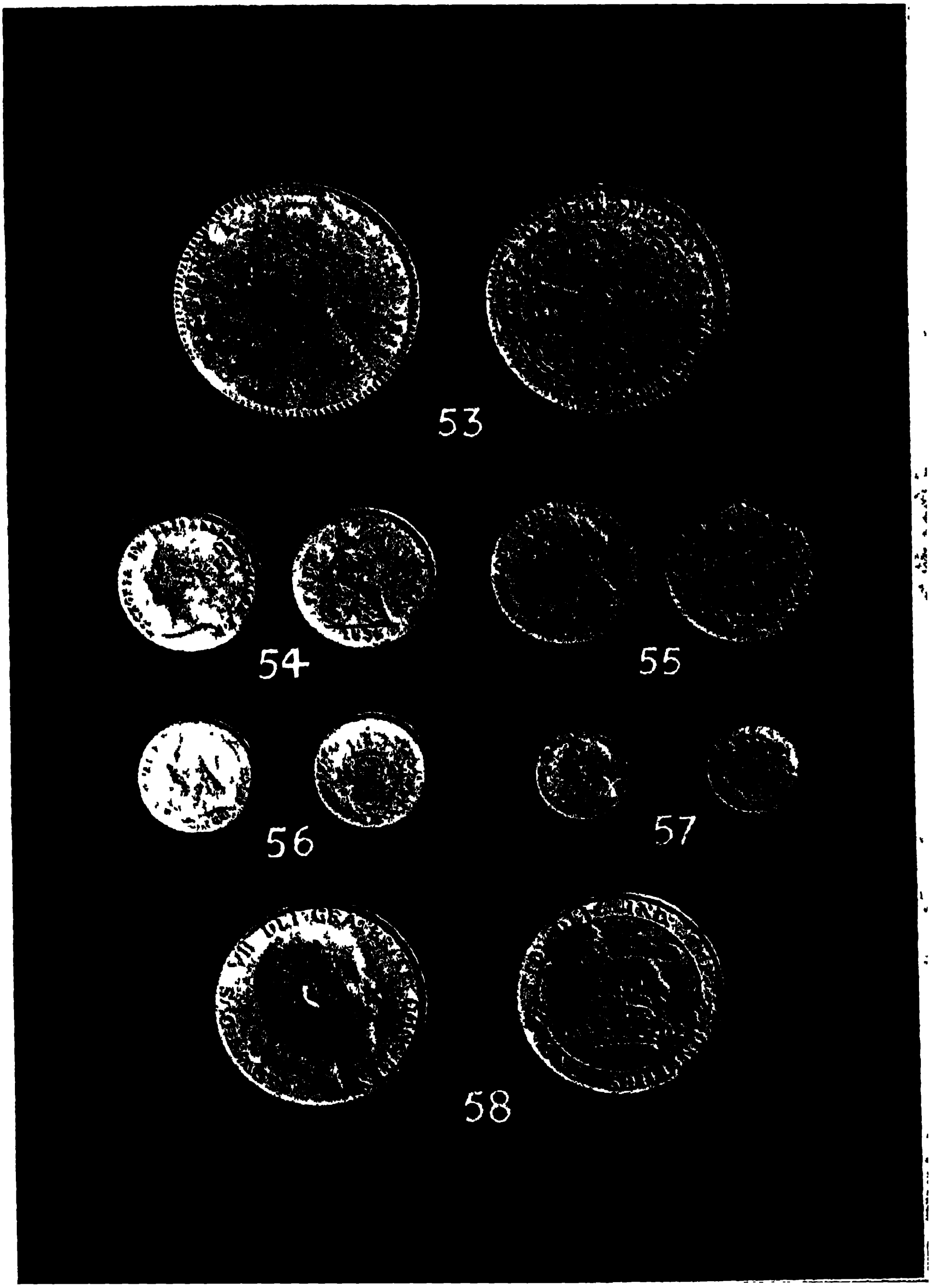
All these coins, except the first one (Fig 40), are of the time of Charles II. The first one is from Commonwealth times The large coins are gold, except the halfpenny shown in Fig 42, and the small coins are copper The two large gold coins were called "broads," and were twenty-shilling pieces Each coin is shown rather larger than the actual size.

TWOPENNY PIECE TO MAUNDY PENNY

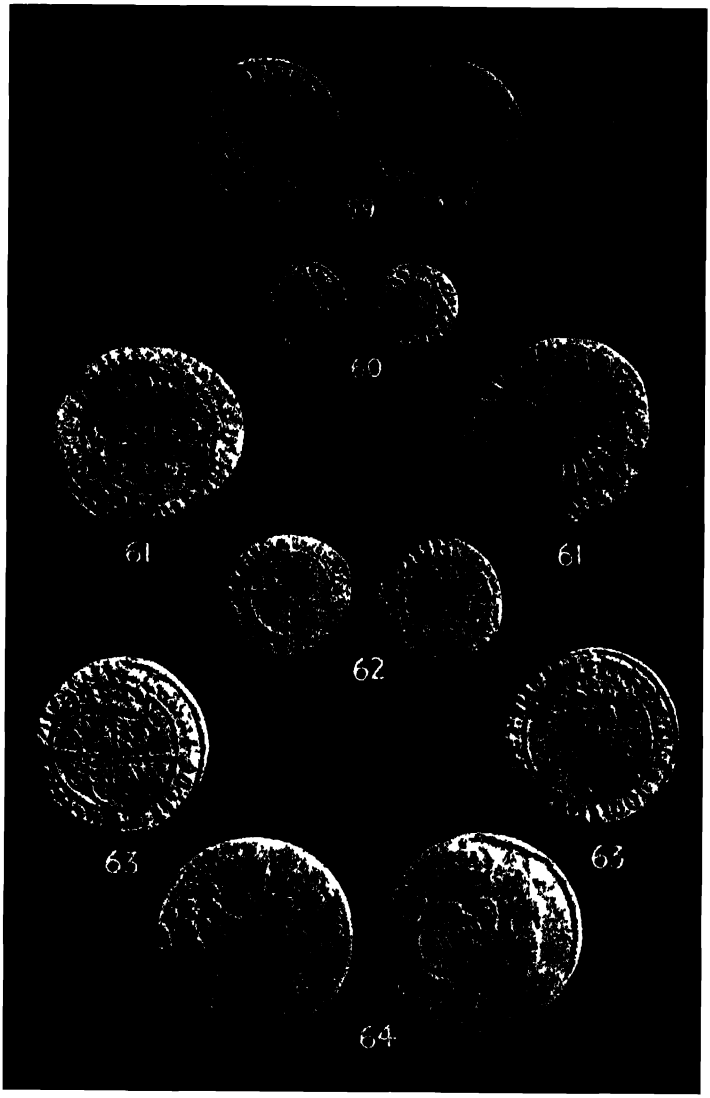


The copper twopenny piece (Fig 52) was used in the time of George III Fig 47 shows a tin halfpenny of the time of James II, Fig 48, a William and Mary sixpence Fig 49, a Queen Anne farthing Fig. 50, one-third guinea of George III, and Fig 51 a Maundy penny

ENGLISH COINS OF RECENT TIMES



The silver coins shown here are all of recent date The florin and the shilling are easily recognisable The florin is of the time of Queen Victoria, in whose reign it was first issued Fig 57 illustrates a silver penny Each coin is slightly enlarged



IRISH COINS. (*Slight reduction*)

In this illustration is shown a collection of old Irish coins varying in date from the tenth century (Fig 59) to the seventeenth century (Fig 64), which represents a halfpenny The head on the halfpenny shown in Fig. 60 is said to be that of St John the Baptist These coins are all silver except that in Fig. 64, which is bronze.

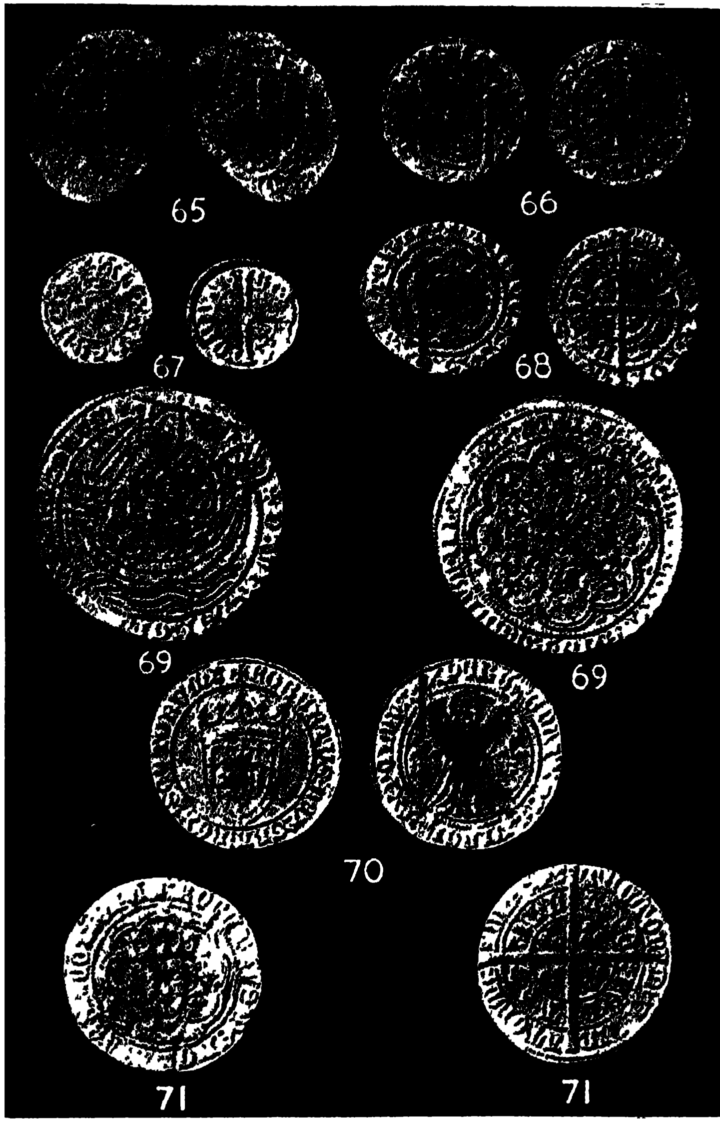
Specially valuable coins, including those of gold, may well have a separate cabinet of their own, which can be entrusted to the further security of a safe. Coin cabinets are expensive things to buy—one may say, very expensive — so the young collector can use some of his time very profitably in constructing a cabinet for himself. If he is fortunate, he may be able to acquire second-hand a plain mahogany cabinet with locking door as a suitable shell for the more costly items, the trays, which will be many in number. Otherwise he will have to make the "cupboard" part to the best of his ability The top and bottom of the cabinet should project sufficiently to be flush with the face of the door when closed, and be a very good fit, so as to exclude dust.

...w to Make Trays

The trays themselves may be pieces of good quality ¼-inch plywood cut carefully to a standard size, which fit the inside of the cabinet closely, but not tightly, so that they may be pulled in and out easily. Round the edge of each tray on the top is glued flat beading, $\frac{3}{16}$ inch thick and ¼ to $\frac{5}{16}$ inch

wide. The interior of the tray is then divided up lengthwise and crosswise, by bars of the same material, into spaces large enough to hold a dozen or more coins apiece. The bottom of each space is then furnished with a loose lining of dark green facecloth—or, if odd scraps of the material can be got from a billiard-table maker, of billiard-table cloth — against which the coins will show up well.

Trays of this kind are suitable for displaying coins in groups or families, and make it easy to keep coins of all sizes together.

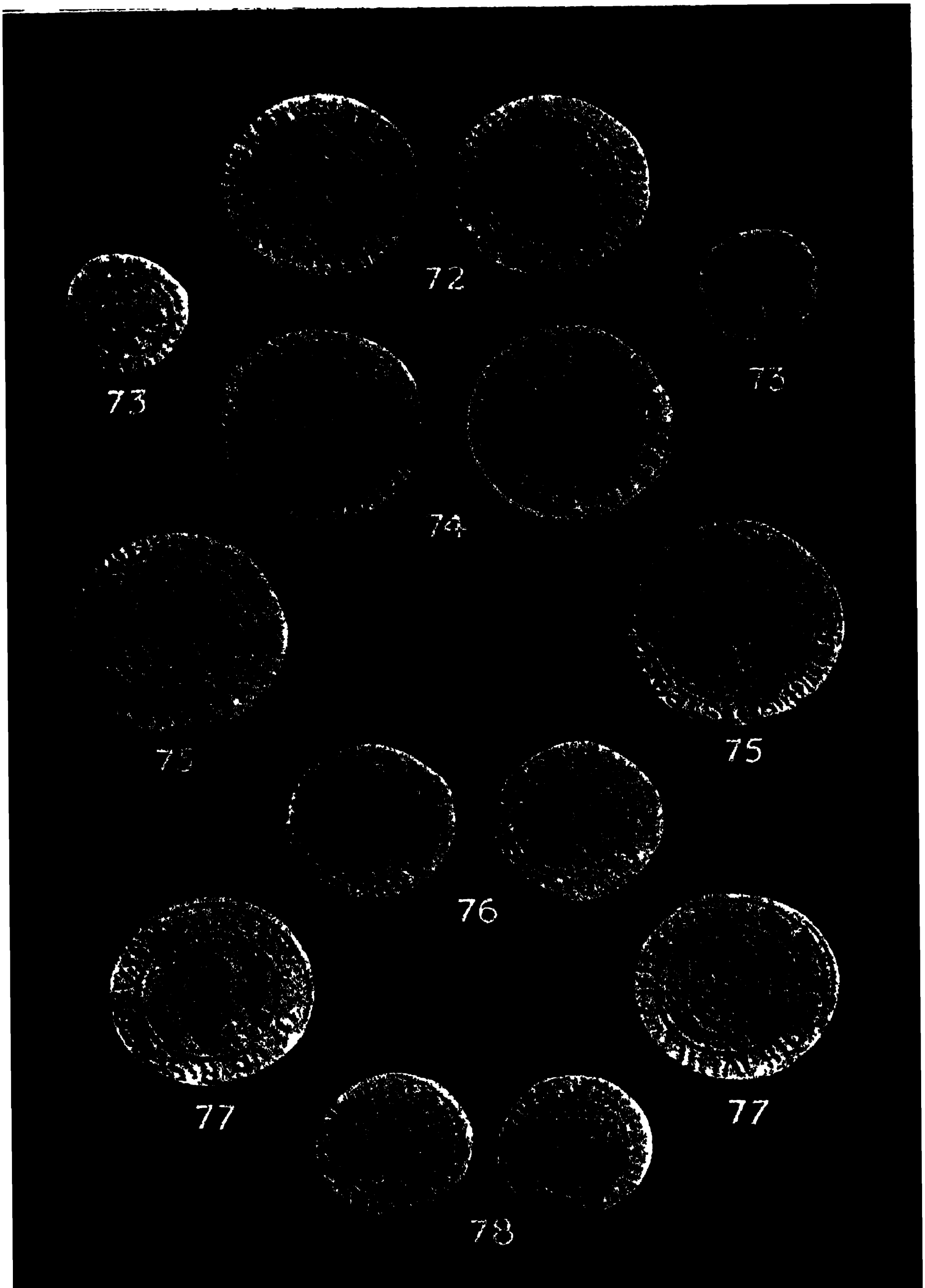


SCOTTISH COINS. (*Slight reduction*)
The illustration shows a group of coins from Scotland The fine gold coin in the middle of the photograph (Fig 69) is a noble of the fourteenth century Figs 65 and 66 are early pennies, Fig 67, a halfpenny; Fig 68, a half groat of the same date as the noble, Fig 70, St. Andrew, and Fig 71, a groat

More elaborate trays, providing a separate space for each coin, can be made out of the same kind of plywood A tray is ruled in both directions with lines parallel to the edges, the crossing points marking the centres of holes-to-be In ruling, allowance must be made for keeping holes at least ½ inch away from any edge The hole centres are then drilled with a small twist drill to guide the centrebits with which the holes are cut right through the tray.

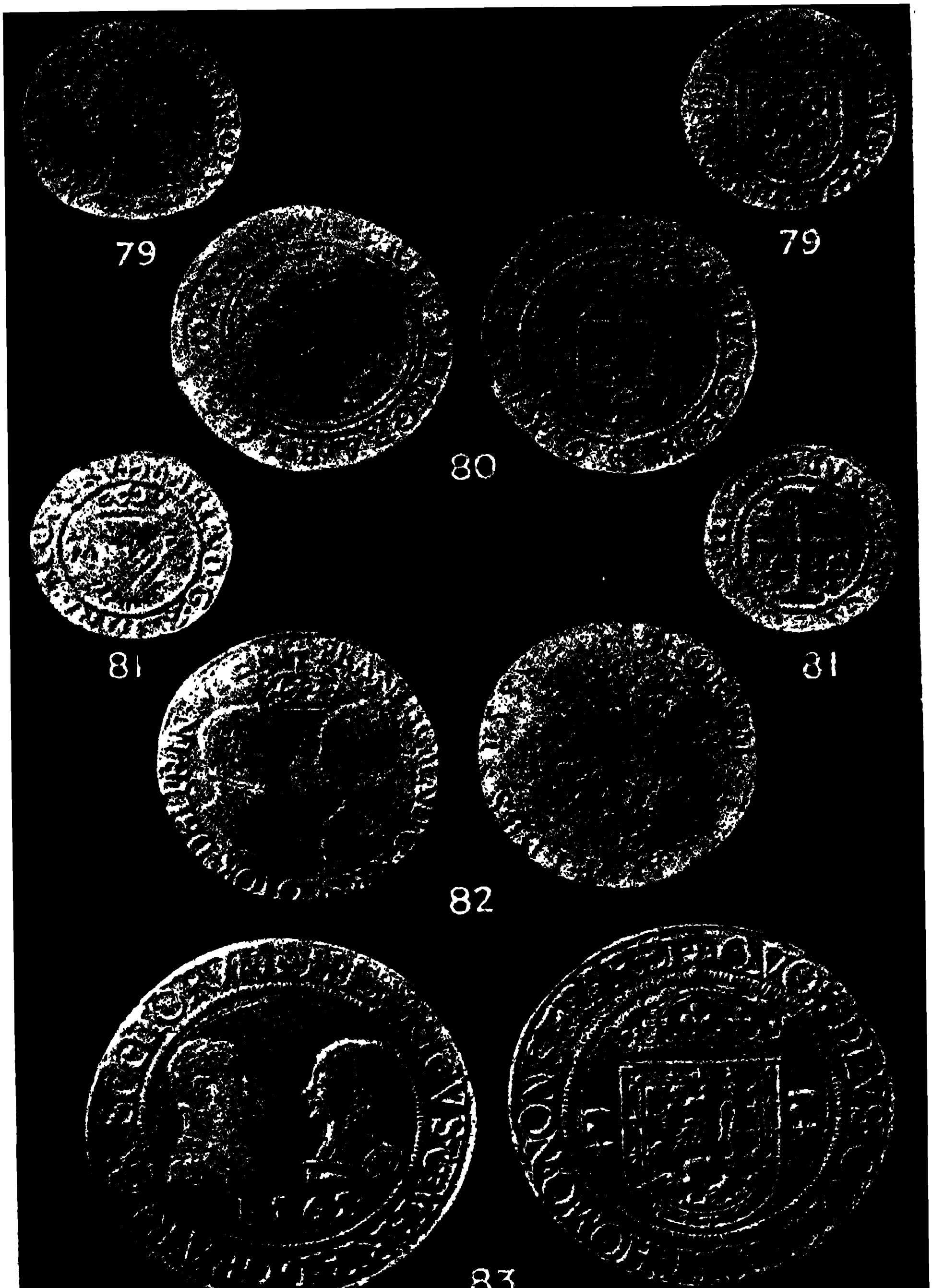
During this operation the tray should be clamped against a piece of waste

A SCOTTISH BONNET-PIECE

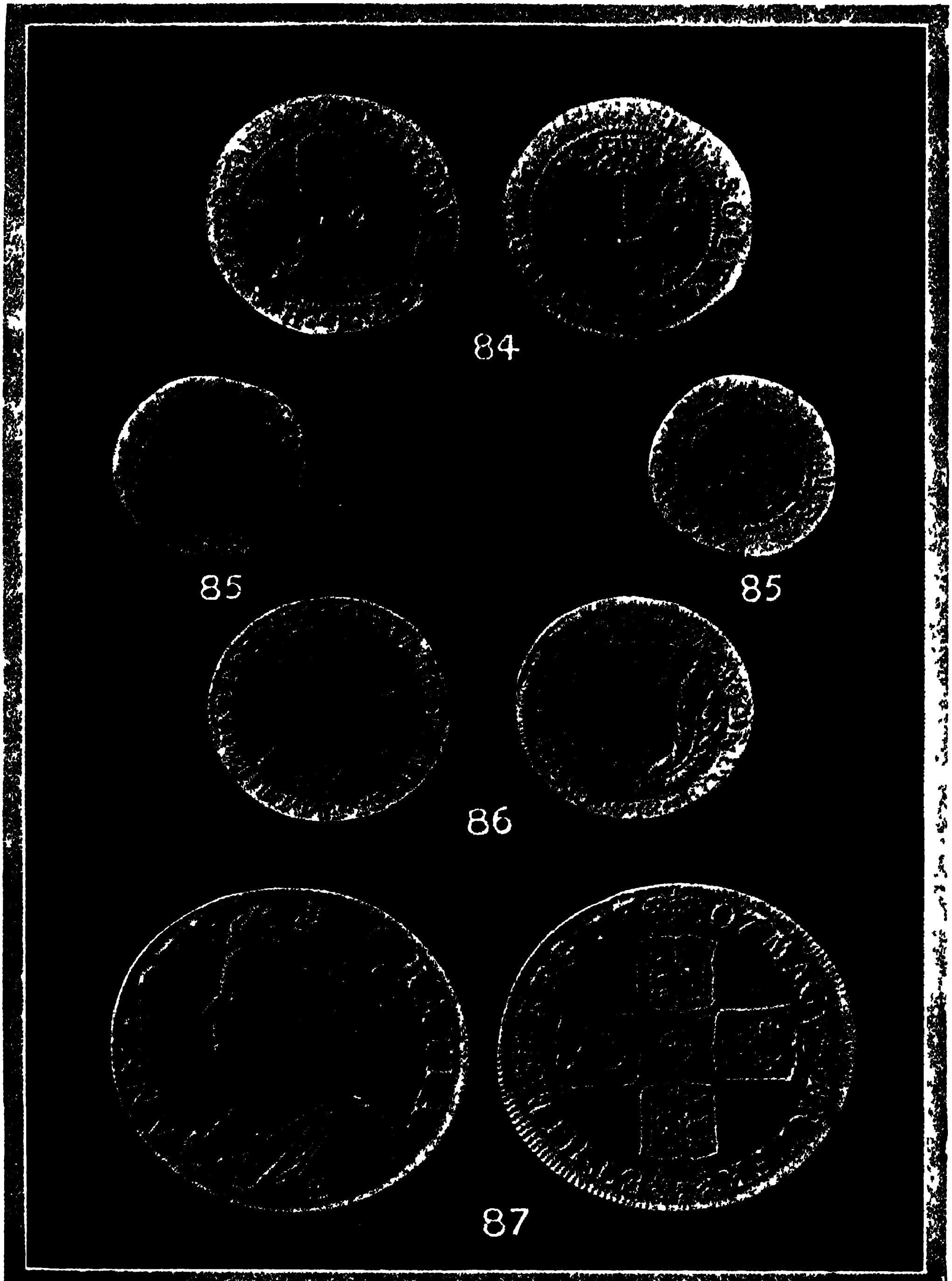


These Scottish coins have curious names: Fig 72 shows a demy (3s 4d), Fig 73, a penny, Fig 74, a rider of gold (23s), Fig 75, a gold unicorn (the animal can be seen on the coin), Fig 76, a plack (2d or 3d.), Fig. 77, a ducat or bonnet-piece in gold, worth 40s.

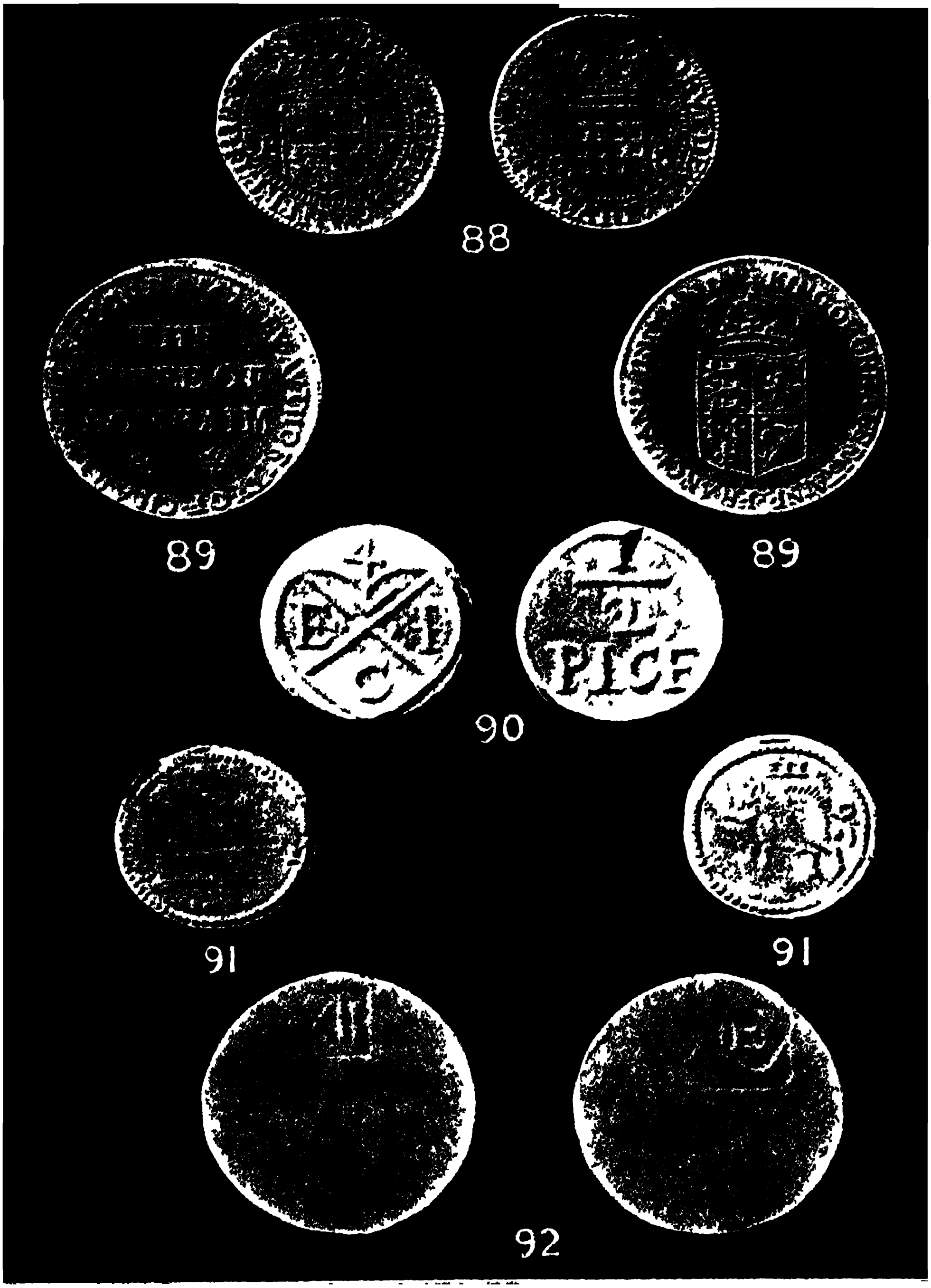
A DUCAT AND A BAWBEE



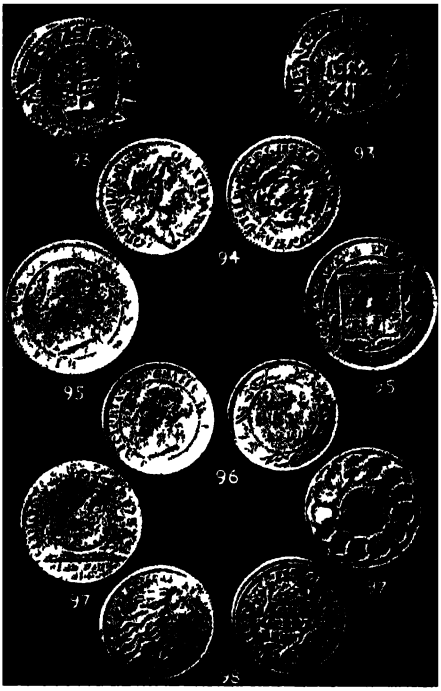
Another group of Scottish coins. Fig. 82 shows a ducat with the heads of Mary and Francis upon it, and Fig. 83 a Silver Ryal bearing the heads of Mary and Henry (Henry Darnley). Fig. 81 shows a bawbee, a coin similar to the modern halfpenny. Fig. 79 shows a half-ryal.

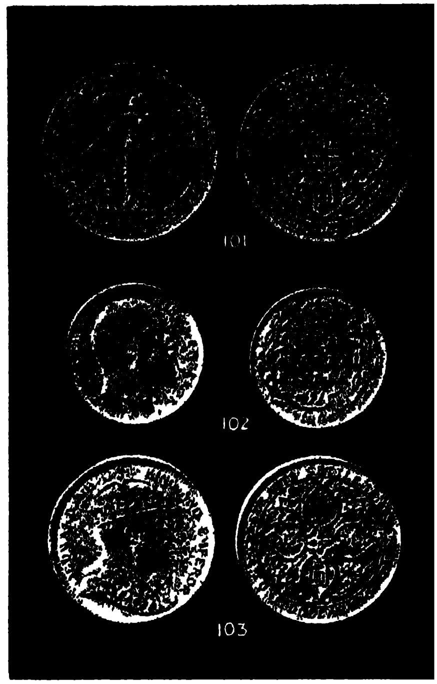


Here are Scottish coins dating from James VI. of Scotland, afterwards James I. of Great Britain. Fig. 84 shows a gold four-pound or hat piece; Fig. 85, a plack; Fig. 86, a bawbee with the heads of William and Mary; and Fig. 87, a crown. The crown is of the time of Queen Anne, whose head appears on the coin. Each coin is shown slightly enlarged.



Here are some Colonial coins The rupee shown in Fig 89 is of the time of Charles II Fig 88 shows the oldest coin of the group, a portcullis sixpence of Elizabeth's time. Fig. 90 shows a half-pice coined by the East India Company, Fig. 91, a threepenny piece from the Sommers Islands, and Fig 92, a New England shilling



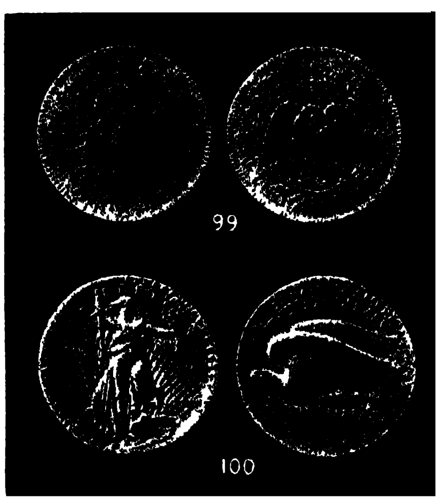


COLONIAL AND UNITED STATES COINS. *(Slight reduction.)*

These illustrations show a group of Colonial and United States coins. Notice the head of the woman and the word Liberty on the coin shown in Fig. 98, a cent. Fig. 97 is also a cent; Fig. 96 shows a Canadian cent; Fig. 93 shows a seventeenth-century shilling from Massachusetts; Fig. 94 a halfpenny; and Fig. 95 a Jamaican penny. Fig. 101 shows a British dollar; Fig. 102, an Indian rupee; and Fig. 103 a Straits Settlements dollar.

wood, into which the bit may bite and so make a clean cut as it comes out through the back surface. The "nicker" of a bit—the point which cuts a circular groove slightly in advance of the sloping blade, or "router"—must be *sharp*, to obtain nice clean holes, and the cutting be done gently. A sheet of cardboard, or, better, very thin plywood (which can be obtained $\frac{1}{16}$ inch thick) is glued to the bottom of the tray, and kept under pressure for twenty-four hours, and each hole is furnished with a neatly fitting disc of green material.

Each tray should be carefully sand-papered on both sides, nicely stained, and provided with a small knob or other attachment in front by which it can be pulled out.



UNITED STATES COINS

Fig. 99.—A half dollar of 1795. Fig. 100. A twenty-dollar piece (gold) of 1907.

Favourite Hobbies: Animals and Birds: How to Manage Them

Four-footed and other Friends in the Home

Studio Lisa

GOING TO A NEW HOME

The terrier seen above in his travelling box is being taken from his mother and brothers and sisters so that he may be sent to a new home This will be one of the greatest adventures of his life, and one wonders if he will be well but prudently fed properly housed regularly exercised and kept clean because upon this will all his future happiness depend

PETS FOR BOYS AND GIRLS

HAVE you ever wondered exactly why we should keep pets? Well, there are several reasons, of course; and you can, for instance, regard a pet as a sort of living toy, far more interesting and companionable than an ordinary toy could ever be. Going further, you may look upon your pets in the light of a hobby and pastime: whilst, in some forms, they may quite well help you to earn a little additional pocket money.

What most appeals to me, though, is that a pet is an individual creature with a character of its very own, to be looked after kindly, well-housed and properly fed, kept perfectly clean and happy Attend carefully to these matters and the pet will become your friend, whilst the very faithfulness of, say a dog, for its young master or mistress is something very beautiful to behold

The Responsibility of Pets

But there's another important point and that is that pets bring with them a responsibility. They are creatures brought to play a part in home life and

so cannot fend for themselves as do their cousins who live under natural conditions. Our pets are all entirely dependent upon us. If you own a pet you must feed it regularly and prudently, neither giving too much nor too little food; see that it has fresh, pure water to drink and that its coat where necessary is groomed and its home kept scrupulously clean.

Now this sort of loving care and attention for our lowly friends, whether they be four-footed or otherwise, teaches girls and boys to be thoughtful and thorough, gentle and considerate, and you will discover before very long that the greater the attention you bestow upon your pets the more they will respond in displaying their affection for you.

In any event, the keeping of any form of livestock will occupy a great deal of time and you must be prepared occasionally to give up an outing or a game with your friends because just then your duty towards the pets is calling you. It is not the slightest use going in for birds or animals at all if you are likely to grow tired of them, leaving Mother to attend to the feeding and Dad to the cleaning of the hutches or cages. If you cannot, with patience and perseverance, manage your pets entirely by yourself, you should never start to keep them.

Now and again, of course, illness may crop up among pets. You may find your doggie's coat rough and he will not wish to have a romp; your cat may desire to sleep all the while and not care about her food; the eyes of your pet bird may be dull instead of bright and its plumage disturbed instead of smooth, though you will very soon get to know from various symptoms when your pet is not in first-class health.

About Pets' Clinics

In such circumstances it would be wise at once to consult your parents because prompt attention might save pain to your pet or perhaps a serious illness. In most towns now there is at least one pets' clinic where children may take their animals and birds for skilled treatment in the case of sickness. Usually, no charge is made to children, though it is nice to put a few pennies into the collecting box in the office. In other districts there may be an animals' dispensary where a charge is made, but money is always wisely spent when it is used to alleviate suffering in the case of a dumb creature, and no pet ought ever to be allowed to linger in sickness without receiving correct treatment.

In some parts of the country there are young fanciers' societies, fur and feather clubs and so forth. It gives one tremendous encouragement to belong to such societies and to the junior sections of these clubs, because one can then learn so much about the animals in which one is

Studio Lisa.

A GOOD PET FOR A BOY

A terrier of this type should form an excellent pet for a boy, being active and alert, hardy and healthy, and always ready for a romp or a run

Studio Lisa

THE SIAMESE CAT

Cats of the Siamese breed are particularly faithful to their owners and almost dog like in their devotion The body colour is creamy with mask ears feet and tail a dark seal brown The eyes of these pussies are usually a decided blue.

interested and meet other girls and boys who have taken up the same kind of livestock Further, there are very helpful shows or exhibitions and every opportunity is given for beginners to compete with their pets in what are termed the novices' classes

Whatever pets you do take up be prepared to devote a certain part of every day regularly to their care and make up your mind you will never fail in your duty towards them It is perfectly true that if, after a while you put other pastimes to the fore and become neglectful of your pets then you certainly do not deserve to have the ownership of such friends.

Pets in A B C Order

It will be wise, so that you can always refer at once to the sub-section in which you are most interested, if I set out the various home pets in alphabetical order. This being so, we can make a commencement with :—

BANTAMS, which are merely small fowls and therefore very suitable for children. There are many different varieties, such as the Rosecombs, English Game, Indian Game and Sebrights, but in town gardens one should keep for preference coloured birds, those that are perfectly white being better fitted for country life As for making a start, the cheapest method is to purchase a setting of bantams' eggs and to place them in the care of a broody hen who will mother the chicks and bring them up April and May are the two best months in which bantam chicks can be hatched and the period of incubation varies from 18 days to 21 days, according to the freshness of the eggs at the time of setting

Housing Though a small poultry house is to be recommended and will last for years with reasonable care, a large packing-case can be used to make a perfectly satisfactory home for a few bantams The case should be turned on one side and have a brick at each corner to keep the woodwork up off the ground The opening, where the lid was originally placed, may be boarded up afresh except for the provision of a door and one panel which may be formed of wire netting ; or, better still, of a small, hinged window The window would be helpful because of ventilation,

Studio Lisa

A CAT-AND-DOG LIFE

If kitten and puppy are adopted together in the family they will grow up to be as happy with each other as this pair of pets obviously are.

but the opening would still have to be covered with netting to prevent the birds from escaping.

A run formed of wire netting on 2 inch by 2 inch wooden posts, with a door for the attendant, is advisable, and such a run can be kept sweet and wholesome if the soil is turned over with a garden fork about once a fortnight. Inside the roosting-place a strong perch about 18 inches above floor level should be provided, as well as a nest box with china egg. In the run a drinking fountain will be necessary and a day perch would be appreciated.

Feeding. Mixed poultry corn is too large for bantams in the ordinary way, though these birds can take wheat and oats. The best fare of all is probably "No. 2 Chick Food," such as corn-chandlers sell, consisting of small seeds, broken grain and dried insects. A well-mixed soft mash is also advisable, especially in the winter. Bantams should have one mash feed, one grain feed and one helping of fresh, tender greenstuff daily.

BUDGERIGARS are small members of the parrakeet family and may be obtained in many colours, blue, yellow, mauve, grey and so on, as well as in the familiar green of the old-fashioned "Love-Birds." Though a single specimen may be kept in a cage in the kitchen or living room and be perfectly happy, most people go in at least for a pair. These pretty little birds breed best in an aviary in the garden, but quite satisfactory results are obtained indoors when a specially large breeding-cage is provided Usually five eggs are laid to form a clutch and the hen commences at once to set. The period of incubation is 18 days; but, as the hen begins when the first egg is laid and it is often a week before she has finished laying, the actual hatching period is sometimes prolonged.

Housing. Fancy cages, round in shape, are often used for budgerigars, whilst others are oblong. The chief point is to have a really roomy home and see it is kept out of direct draught. There should be plenty of bird sand on the floor and cleanliness is most important. An outdoor aviary should face the south and be enclosed on the north and east sides. Nesting boxes are placed on shelves high at the back.

Feeding. The staple food for budgerigars is millet seed, of which there are several varieties. In addition, green food is essential, and many fanciers sow ordinary canary seeds in potfuls of sandy soil in order to raise tender shoots. These pets should never be given meat, but tit-bits of biscuit and such fare in moderation are not likely to harm them.

CANARIES are perhaps the most popular of all cage birds, and have been

bred for so many years as home pets that they are perfectly happy living in cages—which certainly cannot be said of linnets, blackbirds, thrushes and other wildlings Canaries are members of the large finch family, and they, too, thrive quite well in an aviary

Autumn is the best time for the purchase of a canary because then the birds of the new season's hatching are just on the market If possible, you should hear your bird sing, and he ought to be a young cock with smooth plumage, bright eyes and clean and delicate feet and legs Roughened legs are usually a sign of age with all cage birds

Housing. Though round wire cages are very popular, many fanciers prefer a cage that is oblong in shape The floor must be sanded, but a great deal of trouble can be saved if a piece of paper is cut to fit the tray at the bottom and the sand sprinkled over it If the living-room is illuminated with gas the canary's cage should not hang above the level of the burner

Feeding Canaries are fed chiefly on canary seed and rape, such as is sold in packets by cornchandlers In addition they may have a little ripe fruit, green-stuff (especially groundsel, dandelion leaves, clover and the seed-heads of flowering grasses) and a piece of cuttle-fish bone between the wires of the cage or else a spray of millet sometimes for a change See that the drinking water is changed every day

To breed from canaries an unrelated cock and hen should be established late in March in a large breeding cage After a week or two a nesting pan and nesting material (chopped wool, tow, etc , such as is sold in pet shops) must be provided Four or five eggs are laid to form a clutch and the period of incubation is 14 days Just before the chicks are due, begin giving hard-boiled egg finely minced and mixed with biscuit crumbs The parent birds are left together all the time and will feed the youngsters on this special food Not until the chicks can pick up seeds for themselves should they be established in a separate cage

CATS have been kept as pets and also

Studio Lisa

BROUGHT UP ON THE BOTTLE

When nannies are kept for their milk it very often happens that the kids have to be brought up on the bottle, as is here depicted An ordinary glass bottle is used with a special rubber teat and one would generally depend upon cow's milk for the purpose Dipping one's finger into milk and getting the kid to suck it soon teaches these little animals how to feed

for ridding our houses of mice for many centuries and were in Egypt regarded as sacred animals. We have to-day the long-haired cats (such as Persians), short-haired kinds and the quaint Siamese cats, which are very faithful and most interesting. Long-haired cats need frequent grooming with a soft, long-bristled brush, but it should seldom be necessary to use a comb unless the coat has been neglected and become tangled. Short-haired cats usually manage to keep themselves properly groomed. In the case of white cats, they may easily be cleaned as follows. Take some flaky bran and heat it in the oven. Rub this warm bran well into pussy's coat with your fingers and afterwards brush it out, when you will find the coat has become perfectly clean.

Studio Lisa

BOTH GROOMING AND SPRING-CLEANING

If you go in for a dog he must be bathed occasionally and have a regular grooming so that his coat may be healthy. His kennel will also call for frequent cleansing and fresh bedding.

Every cat (or kitten) should have its own bed and an ordinary grocery box answers the purpose very well, especially if you screw a small block of wood to each corner at the base just to keep the box up off the ground. Folded sheets of brown paper should be laid at the bottom of the box and then an old rug or blanket, also folded. Keep the box permanently in the same corner of the kitchen out of draughts, and never allow a cat (or any domestic pet, for that matter) to sleep in your bedroom.

Feeding. A kitten newly taken from its mother needs to be fed regularly every two hours just at first.

Studio Lisa.

BRINGING UP THE FAMILY

When first they leave their mother puppies must be fed every two hours, but be given only small helpings of food. These four puppies are thoroughly enjoying their ration of warm milk.

Warm bread and milk should be the chief food at this stage, with a little boiled fish, finely minced meat and such fare, at least once a day.

Care in Feeding

A grown-up cat needs only two meals daily. Boiled cods' head with the flesh picked carefully from the bones; meat with a little green vegetable; bread and milk; boiled liver; the cheap tinned salmon; prepared food as sold by cornchandlers for puppies—these are all good for cats, but you must never allow pussy to become an eater of meat and nothing else. Potato food in large quantities is not good for cats.

Be sure to provide a cat (or kitten) with a proper sanitary box for the night. A shallow wooden box filled with a little garden soil and sifted fire ashes answers the purpose very well.

Dogs were probably the first animal friends man ever had, and there are to-day no fewer than ninety-four separate breeds. Very large dogs, such as Great Danes and Alsatians, are suitable only for life in a kennel; just as Cairns, Pekinese and Pomeranians are happiest living in the house as "members of the family." For boys, one would recommend active, sportive dogs such as Airedales, terriers of many kinds, Spaniels and so forth. Knowing little Dachshunds and Highland White or Scottish terriers are very companionable for girls. So far as Spaniels go, they do need a great deal of hard, regular exercise and these animals soon become fat and lazy if they spend too much of their time sitting in front of the fire or on soft cushions.

The actual choice of a breed must naturally depend chiefly on your own inclinations. If you have a kennel dog,

P.A.—Reuter Photo.

A NEWCOMER AMONG PETS—THE GOLDEN HAMSTER

Until 1945 the Golden Hamster, a small rodent about six or seven inches long, was almost unknown to the general public. Since then it has rapidly become a popular favourite. Hamsters have all the attractive qualities to be desired in small pets. When handled regularly they are very tame and full of harmless tricks and twists They need no special food and thrive on dog biscuit, vegetables, fruit, dry bread and grass

see that his home is kept scrupulously clean with plenty of fresh straw inside as bedding and a wooden platform outside on which he may sit in the sun and where his drinking water may be kept. See also that the chain is sufficiently lengthy and that your pet is not chained up for too long at a time. It is very easy to fix a stout wire along a fence or wall and to have a ring at the end of the dog's chain through which the wire may be passed. Such an arrangement ensures ample freedom.

Dogs and Cushions

Every house dog should have its own box (much as recommended for cats) and not be allowed to use the chairs or cushions of the home, whilst it is bad for these pets to sit in front of a blazing fire. A small lap dog should have a circular basket.

Whatever sort of dog you keep, it must have regular exercise according to the breed, and you must be willing to take it for a run before breakfast and last thing in the evening in any event.

Always use a lead in the street, but try to find a field, park or some such place where your pet may have a scamper on the grass at least once a day. Never, however, exercise your dog immediately after a heavy meal. Swimming is excellent exercise, especially for spaniels and all such water-loving dogs. Rough-haired dogs and those with long coats require to be brushed and groomed.

Feeding. Puppies, just as they leave the mother, must be fed every two hours at first and given only small helpings—as much as they will clear up hungrily and no more. At six months three meals a day are ample and a grown-up dog needs but two.

Very young puppies may have warm gravy or warm milk, mixed with broken stale bread or else puppy biscuit; the prepared puppy food such as corn-chandlers sell; raw meat, finely shredded, three or four times a week; occasional well-cooked greenstuff and so on. A grown-up dog may have meat from the joint, cut up small, with green vegetables but not very much potato as one of his two meals. For the other he should have "hard tack" for the sake of his teeth, such as dog biscuits or the crusts of stale brown bread. A large meat bone is good for a dog, but not the bones of poultry or rabbits.

Training. When training your dog be always firm and make him understand from the first that he has to do what you tell him. Do not scold him for a naughty action one day and be amused at him when he does it next time, for you must always be just. Whipping a dog is in no circumstances to be advised, nor is it likely to do the slightest good. A well-trained doggie knows by the tone of your voice when you are cross with him.

If you wish your pet to perform tricks, you must begin the lessons whilst he is still quite young and make up your mind to be very patient with him, never forgetting some little reward when he makes good progress. Standing the animal in a corner and teaching him to "beg" is probably the first and easiest trick of all to teach. Stamp out any tendency to cadge for scraps of food at table because a dog who so behaves quickly becomes a nuisance. In the same way, allow no "snacks" of food in between the normal meals and see that meal-times are strictly regular.

Your Dog Licence

To keep a dog six months old and older it is necessary to take out a licence costing *7s. 6d.* a year and obtainable at most Post Offices. It is the owner who is licensed "to keep one dog" and so the licence itself is not transferable with a dog. Licences all date from January 1st in any year and are due for renewal on that date.

FOWLS can hardly be classed as pets, but they are full of interest and may be made most profitable. Girls and boys who begin with bantams often go on to keep fowls, and there are a great many

THE GUINEA-PIG OR CAVY

Guinea-pigs are quaint little pets, easy to manage and to feed when one has a large garden. They are quite defenceless and always gentle.

separate varieties though only two main groups.

In the first group we have the "general purpose" fowls, such as Rhode Island Reds, Orpingtons, Wyandottes, Sussex, Plymouth Rocks and so forth. With these breeds and hens make dependable mothers and the cockerels can be fattened to a good size for table. In the other group come the "light" breeds, such as Leghorns and Anconas. Here the cockerels never attain to a great size and the hens do not go broody. For children, however, Leghorns are probably the best breed of all to take up: White Leghorns in the country and birds with dark plumage for town gardens. Leghorns are small, active fowls but they lay remarkably well and their eggs are large.

If you decide to take up fowls you can begin in one of several ways. You can, in the autumn, purchase pullets (*i.e.*, young hens) and if you buy from a good poultry farm the birds will probably have been running over corn stubbles. You can buy day-old chicks in April and give them to a reliable broody hen to rear. Or you can buy a setting of eggs and slip them under a broody hen, the period of incubation being twenty-one days.

Housing. For your birds you will need a roosting-shed equipped with perches and nesting boxes and a run adjoining with sides and roof of wire netting. The best flooring for the shed would be plain earth rammed down firm and sprinkled with sifted ashes. The soil of the run should be turned over with a garden

G.P.A.

MR. PRICKLES, THE HEDGEHOG

If you make a point of feeding a hedgehog at the same regular time each evening with a saucerful of bread and milk he will come for his meal and get to know you.

L F A

A LONG-HAIRED CAT

Persians and other pussies of this type need to have their coats brushed and groomed almost every day.

fork frequently, and it would be advisable to dig in a little lime every now and again. In an orchard or paddock a portable shed is best, one that can easily be moved by lifting and carrying, by pushing it along on its small wheels or else by means of sledge runners.

Feeding. In the ordinary way, grown-up fowls require feeding three times a day. In the winter the best breakfast would be one of warm, soft mash, with fresh greenstuff at mid-day and grain (oats, wheat and kibbled maize) about one-and-a-half hours before roosting time. In the summer the grain should be given for breakfast, the greenstuff as usual and the mash (cold) in the evening.

Soft mash is made from well-cooked house scraps, best flaky bran and middlings and a much smaller quantity of Sussex ground oats and meat meal Potato fare is excellent for birds in the fattening shed, but is not advised for the layers in any great quantity. All fowls must be given crushed oyster shell and flint grit because it is with this material they grind up their food, having no teeth.

Baby chicks are fed for the first three days on hard-boiled egg minced up finely and mingled with the crumbs of stale bread or biscuit meal with just a sprinkling of pinhead oatmeal. After that they may have (small helpings every two hours) "No. 1 Chick Food," such as cornchandlers sell, consisting of small seeds, cracked grain and dried insects. Between two months and three months they have (at longer intervals) the "No. 2 Chick Food", and, after that, much the same food as adult fowls.

GOATS are splendid pets for children living in the country, more especially when there is an orchard or paddock

Studio Lisa

CAUGHT WITH A CARROT

These two bunnies seem quite unconcerned at being photographed, probably because of the carrot. Rabbits are most interesting pets and can be made very profitable.

available. The finest goats are the Toggenburg, from Switzerland, and the Nubian, which has long ears but not horns and is a large animal.

Goats may easily be taught to draw a small carriage for quite tiny children, but they are more often kept solely for their milk, which is specially good for babies and invalids, though it may be used for all sorts of household purposes. Goats are milked at strictly regular times twice a day and it is usual to stand the animal on a low wooden platform and for the milker to sit upon a stool.

From April until October nannies are generally tethered out-of-doors where there is rough pasturage, such as on the green verge beside a lane, in an orchard, on a common or some such place. A nanny would wear a heavy leather collar to which the tethering chain (some 10 feet in length) would be attached, the other end fastened to an iron pin driven into the ground. Tethered goats are moved to fresh positions two or three times during the day, according to the amount of herbage.

During the winter months the goats would live in a stable, being taken out for exercise only during favourable weather, As a rule, the stable door would be made in two parts so that the upper half could remain open in fine days, whilst hay is fed from a rack in one corner. In addition to green herbage and hay, milking goats require crushed oats, pieces of carrot, parsnip, swede or other root crop washed, chopped up small and served in a clean enamelled bowl. In the depth of winter a little cattle-cake is also given.

Goats require a daily grooming with a dandy brush and the parts must be carefully washed and dried (as must the hands of the attendant) before milking begins.

GOLDFISH can never be happy in a small circular bowl with the sun full in their eyes and nothing upon which to live but a few so-called "ants' eggs." To keep these pets with any real satisfaction a glass tank is essential; and, to maintain the correct balance of life, some water plants (obtainable from most pet shops) should be established in sandy shingle at the bottom and some ramshorn snails be provided as scavengers. Further, if the glass faces a sunny quarter it should have green paper pasted upon it or else have a little green paint brushed over the surface.

Fish will eat the leaves of many water plants, and other plants are said to be "oxygenating," which means that they produce air bubbles for the inmates to breathe. The snails prevent the greenish growth from forming on the glass, and in such a home fish will

Studio Lisa.

A SOLEMN-EYED SPANIEL

This faithful spaniel is obviously a "perfect dear," but an expert would say he is rather too fat and that a pampered life on soft cushions is harmful to him.

live happily for a great many years whilst the water scarcely ever needs changing. Generally speaking, one should allow a gallon of water for every inch of fish, not counting the tail. Thus, a tank containing four gallons of water would hold two fish each 2 inches in length, or four fish each 1 inch long. Overcrowding is a great mistake with these pets.

The best food of all is that specially prepared and sold in packets at pet shops. Ants' eggs are only for very large fish and meat is harmful. Bread is definitely inadvisable, more especially when it becomes stale in the water.

Epsom salts form the best medicine for goldfish that have been overfed and become sluggish. Many fanciers put half-a-teaspoonful of these salts into a small aquarium once a week.

GUINEA PIGS make excellent small pets and may be obtained in several varieties, Abyssinians, Peruvians and so on, chocolate and white, black and white, self-coloured and with various markings. The males are the "boars" and the females the "sows" and these animals live very happily in a large box, with hay on the floor as bedding and a small wire netting run attached in which they may feed.

Feeding is a very simple matter, especially during the summer, when these pets may be given cabbage leaves, dandelions, sow-thistles, lettuce, cut clover, the foliage of artichokes and sunflowers and a great deal of other greenstuff from the garden. Whatever green food is given, however, it should always be dry and absolutely free from frost.

Bread and milk is particularly acceptable to "cavies" (as guinea-pigs are called) and for dry food they may have a mash made from one measure of bran and two measures of sharps or middlings. Another favourite dish is crushed oats mixed with a little chaff, but if oat food is given too freely, skin trouble may result.

Guinea - pigs require water to drink, and these pets must be kept specially clean.

HEDGEHOGS are really wildlings and one is most likely to see them in the dusk of the evening or after a shower. If you wish to take a hedgehog home and get it happily established in your garden, spread a duster or old handkerchief on the ground and roll the hedgehog into the middle. Now gather up the four corners and you can carry your captive quite easily.

Hedgehogs are useful in the garden because of the pests they devour and they will clear a kitchen of black beetles. Bread

Fox Photos.

A TRIO OF "REX" MICE

These fancy mice were bred at a mouse farm in Essex and have a wonderful "wave" in their coats. They are very fond of brown bread and will make a home in the loaf after a meal.

WHAT AN AQUARIUM LOOKS LIKE

It is often cruel to keep goldfish in a small glass bowl especially in the full sun. In a proper aquarium, however, these pets are perfectly happy and live for a great many years. Growing from the sandy bottom of the tank there should be selected water plants and a few ramshorn snails will act as scavengers

and milk is the food they most appreciate, and if you feed your pet regularly at the same hour each evening he will turn up just as regularly for his supper. These animals hibernate during the winter.

MICE are available in many varieties, and all sorts of distinctive colourings and markings, interesting specimens being usually exhibited at various fur and feather shows. If you can make a start with an unrelated pair it will not be very long before you have quite a large stock.

Housing. Fancy mice are usually kept in boxes with plenty of clean sawdust on the floor, though peat moss is equally satisfactory. It is a good plan to have a glass front to each box so that the inmates may be watched.

Feeding. The sort of food to provide for fancy mice is: bread and milk; bird seed; crusts of stale bread; pieces of carrot or other root vegetable or of ripe apple; heads of flowering grasses or a piece of tender lettuce; crushed oats, very occasionally. Change of diet is important and no stale food must on any account be left in the hutches.

Young mice are taken away from their parents at four weeks, when the bucks must be separated from the does. The best method of picking up these pets is to take them firmly by the tail, fairly near the body.

PIGEONS are most interesting pets, especially those which one takes in a basket on a bicycle some distance away so that they may fly back home. For the garden Fantails are splendid, living in a cote which may be affixed to the top of a post, the cote being divided into separate compartments for each pair of birds. Homing and such pigeons, however, would not be happy in one of

Fox Photos

A COCONUT FOR THE TITS

Tom tits and others of their kind are winter visitors to our gardens. They enjoy coconut, peanuts threaded on string, and pieces of suet or other fat or coconut meal alone.

these cotes and so a loft is usually provided which may be a special shed on the ground or even an attic at the top of the house. Where there is a loft the floor must be freely covered with rather coarse sandy gravel and perches provided for some breeds, whilst others have brackets shaped something like a letter V upside down.

You can make an excellent start with pigeons by buying a pair of unrelated birds from March to June. Put them together in a cube sugar box with a front of wire netting, and after a few days, provide a nesting pan (from a cornchandler or china stores) and some straw cut up into short lengths. Presently the birds will complete a rough nest and probably an egg will be laid one afternoon and another about 48 hours later, two eggs forming a "clutch." The parents will sit in turn and the period of incubation is eighteen days.

Feeding. Generally speaking, it is only necessary to buy a grain mixture from the cornchandler made up according to the breed of bird and time of year. The birds are fed twice a day, morning and evening, and it is most important to see that the drinking water is always pure. In favourable weather, pigeons should be given an enamelled bowl of clean water daily in which to bath.

RABBITS are always most popular as pets, and girls are particularly fond of Angoras with their long wool and pretty tufted ears. Our biggest domestic rabbits are Flemish Giants and Belgian Hares. Dutch and Old English are a good deal smaller, but the Lop-eared is rather a large animal. Beverens, Chinchillas and Havanas are kept for their pelts or skins.

Housing. The size of hutch for one's rabbits depends entirely on the breed, but there should always be plenty of space for the animal to turn round as it will get no other exercise. Usually a hutch 20 inches in length, 18 inches in height and about 18 inches deep will answer one's purpose and be very easily made from an old box.

Grown up rabbits do not live peacefully together so there must be a separate hutch for each adult and it is wise to partition off about one third of the hutch to form an inner or sleeping compartment. Here soft sweet hay is provided for bedding, whilst in the outer section the floor has to be littered freely with clean sawdust or else peat moss. With many rabbits the hutches may be built up in tiers one above the other so long as there are strips of wood between every pair of hutches.

Feeding. This must depend to a great extent upon the time of year. Damp frosted greenstuff is fatal to these pets, as is the foliage of ivy, privet and other evergreens. One may broadly speaking, give any of the following foods to rabbits and change of diet is beneficial. Dry, tender greenstuff from the garden; soft, sweet hay or else clover hay, which is harder; mashes made from best flaky bran with strained tea leaves or crushed oats with a little chaff, or well cooked potatoes (or parings) with barley meal or middlings or one measure of bran and two measures of middlings; crusts of stale bread, perhaps just

"crisped" in the oven; pieces of carrots, parsnips or swedes, free from frost, washed and then cut up; pieces of ripe apple; bread and milk and the special food sold for rabbits by cornchandlers.

Young rabbits are taken from their mother when about six weeks old, but are left a little longer in cold weather. If you have occasion to lift a rabbit by the ears always support the weight of the animal's body in the other hand. The wool of Angora rabbits is clipped with round-ended or nurse's scissors when 3 inches long, half-an inch of wool being always left on the animal.

RATS, like mice, are available with many different markings and colourings and the white ones with pink eyes are popular. They are usually established in hutches with glass fronts and it is most important that they are kept absolutely clean. One buck may run with two does, but the young ones should be separated from their parents at about six weeks, the bucks being then parted from the does.

Feeding. For fancy rats, bread and milk is quite a staple dish. One may give also boiled rice; hard bread crusts; pieces of carrot or ripe apple; seed heads of grasses and dandelion leaves, but very little corn or oats.

Lettuce and Mulberry

SILKWORMS are of the greatest interest and a start should be made in early April by purchasing some eggs from the nearest pet shop. The eggs are then placed in a ventilated cardboard box and before long, caterpillars will hatch and need to be fed at first on fresh lettuce leaves; and, later on, with mulberry leaves, though these are usually not available until May.

Keep the box very clean, the best plan being to cut a piece of white paper exactly to fit the bottom of the silkworms' home. If you ever have occasion to pick up a caterpillar, do so with a small camel's-hair brush and never with the fingers.

The caterpillars will grow to a considerable size, with occasional changes of coat, and eventually commence to spin silk and form their cocoons. It is when this stage has been completed that one may wind the silk, though for the amateur there is very little practical use for the silk thus obtained.

Our Garden Wildlings

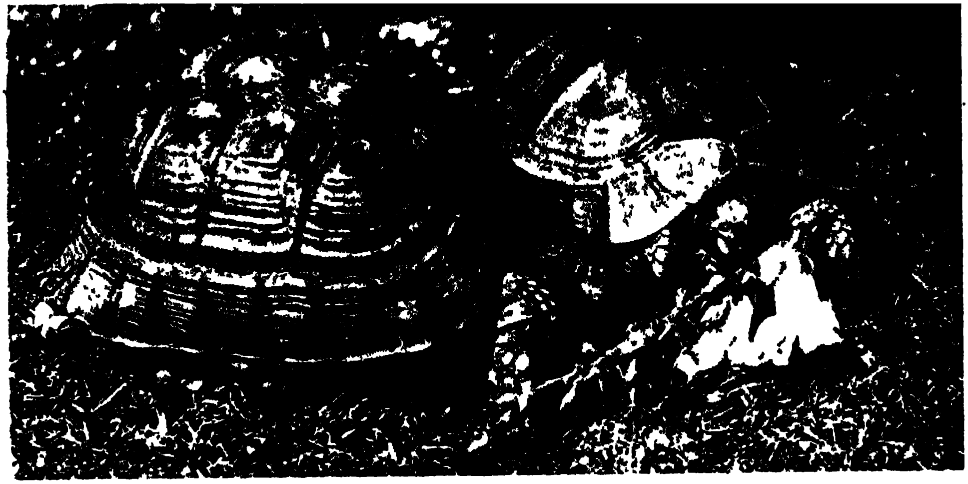
TOM-TITS count among the wildlings and are frequent visitors to our gardens during the winter months. They enjoy particularly half a coconut suspended by string from the branch of a tree or a convenient piece of wood and are equally partial to a chain of pea-nuts threaded on twine and hung beneath a verandah. Even a meat bone or piece of suet conveniently suspended will attract these little birds, who cling upside down and in all sorts of queer positions as they feed.

For ordinary wild birds, a table consisting of a flat piece of wood on a stout pole answers splendidly. Some birds like crumbs, meaty tit-bits, meal worms and so forth, whilst others will take seed. All are keen to have drinking water, especially in frosty weather.

Studio Lisa

FANTAILS ON THEIR GARDEN HOME

Fantail pigeons are specially suited to life in a cote in the garden, and this particular cote is of most ingenious construction



Fox Photos

TORTOISES WILL EAT FLOWERS

These tortoises have high-domed backs and are of the land variety. Though they enjoy warm bread and milk, they are by nature vegetarians, and their food usually consists of lettuce leaves, dandelion foliage and similar fare. At the same time, they are quite partial to flowers.

TORTOISES are, of course, reptiles, and there are two sorts commonly kept as pets. The first is the Land Tortoise, with rather a high domed back, and the second the Pond or Water Tortoise, whose shell is much lower and who may have his hind feet webbed like those of a duck.

A Home for a Tortoise

Housing. Owing to their habit of wandering and their propensity for tender seedlings in the garden it is wise to have a box turned on its side as a home for a land tortoise. A little hay may be placed in the box as bedding and one should build round it a pen of narrow wire netting attached with tarred string to upright bamboo rods. Such a pen is very easily movable.

Water tortoises are happiest when there is a shallow pond in the garden; and, where necessary, it is worth while to make one specially by sinking a shallow metal bath or some such receptacle in the ground.

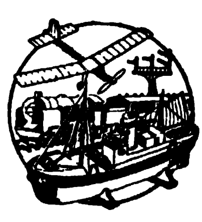
Feeding. Both types of tortoise find a saucer of bread and milk acceptable. The land tortoise is, however, a strict vegetarian and will enjoy mostly fresh lettuce, dandelion leaves, cut clover, sunflower foliage and similar fare. Water tortoises live entirely on small worms, grubs, slugs and insects.

These pets hibernate or sleep away the winter, the land variety digging holes and burying themselves, whilst their water cousins prefer the mud of a pond. When a tortoise fails to hibernate naturally it should, towards the end of September, be placed in the middle of a deep wooden box packed round with leaves, hay and straw and put away in a cool shed or cellar until the spring. Even then, when first it wakens, it will need to be kept in a warm place by night.

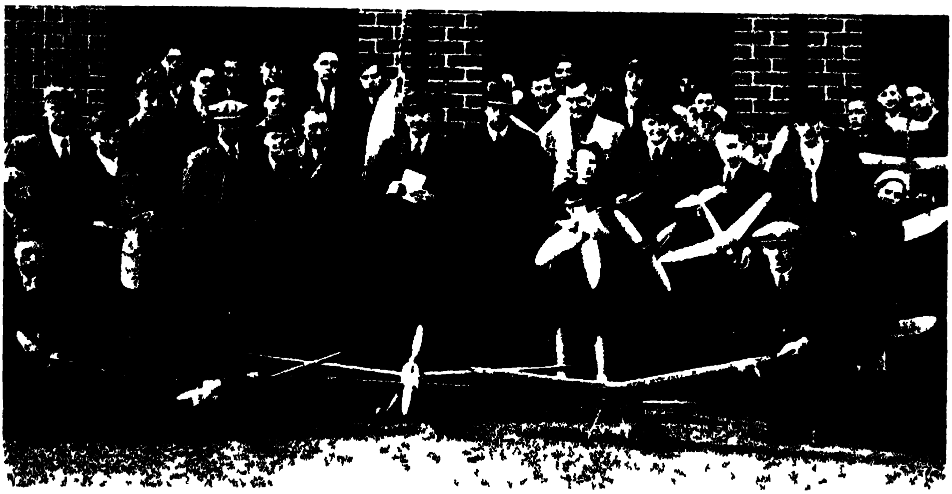
After Hibernation

Another point is that after the winter's sleep your tortoise may have his lips and eyes encrusted with saliva. If this happens bathe twice a day until the trouble has been removed, using a swab of cotton wool dipped in warm water with a little boracic powder.

Favourite Hobbies: Things To Make and Do



Models and Model Making



Model Aeronautical Press Ltd

THE FASCINATION OF MODEL AEROPLANES

Ever since there have been aeroplanes in the skies models have been cleverly constructed and flown not only by boys but by girls as well and this is now one of the recognised hobbies. In the picture above we are shown some members of the Rotherham Model Flying Club. A competition has just been held and everyone is taking an interest in the winning models.

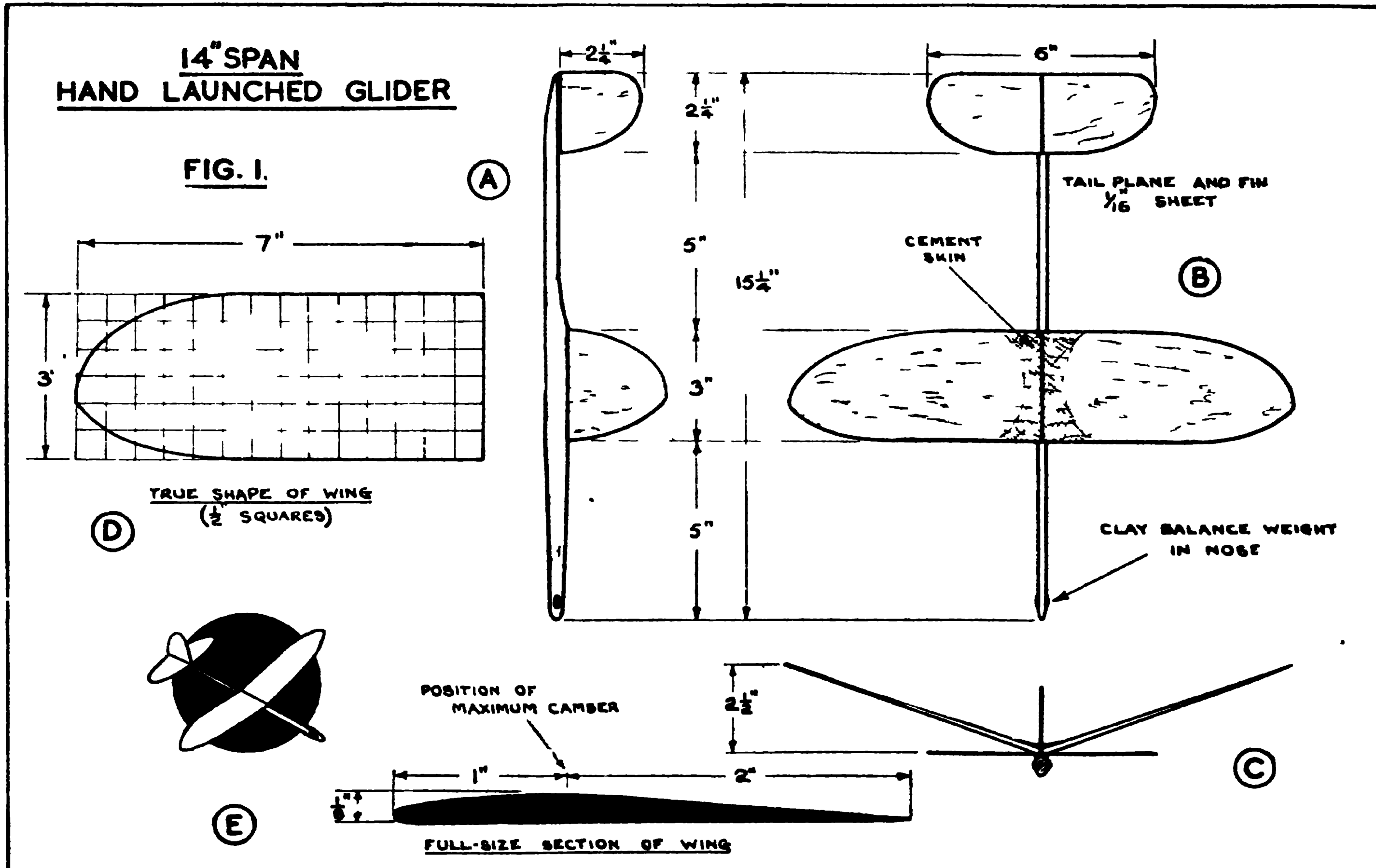
A 14-INCH SPAN GLIDER

THIS little glider is very easy to construct, needing but a small amount of material and few tools, yet, if made according to the directions, it will prove an excellent flier. All the material required may be bought from a shop dealing in model aero supplies.

The materials needed are these: A strip of ½-inch by ⅛-inch spruce or pine for the fuselage, some ⅛-inch sheet balsa wood for the wings, some $\frac{1}{16}$-inch sheet balsa for the tail surfaces and a tube of balsa cement for making the joints. You can do most of the work with a razor blade and a sheet each of M2 and F2 glasspaper, although a small drill and saw would prove useful. Choose a razor blade of the type that has a stiffening piece over one edge. If you use the double-edged type you must fix it in a holder to stiffen it and protect your hand.

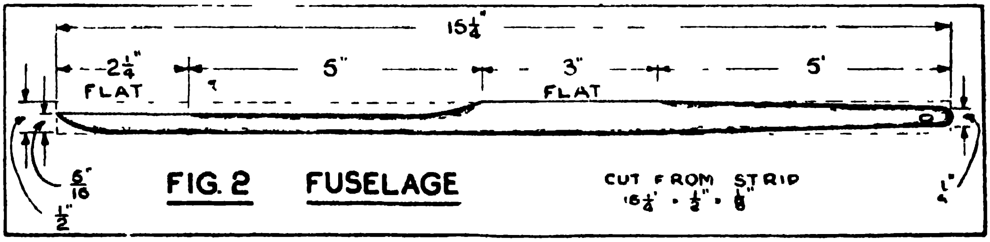
The main sizes of the model are shown in Fig. 1, from which you will see that the slender fuselage projects some way in front of the wings and has a balance weight in the nose. The wings have plenty of dihedral (*i.e.* slope upwards and outwards, Fig. 1c) which makes for stability.

Start with the fuselage. Make sure that your piece of ½-inch by ⅛-inch strip is straight, and cut it to a length of 15¼ inches. Put marks at the points shown in Fig. 2. Taper the nose as shown and thin down the part aft of the wing position to $\frac{1}{16}$-inch deep. With your glasspaper round off all the corners



DIAGRAMS REQUIRED FOR THE SPAN GLIDER

The diagrams above (Figs. 1A, 1B, 1C, 1D and 1E) give the main sizes of this interesting model. Most of the work can be carried out with an old razor blade properly stiffened to protect the hand and glasspaper of the right grade



When making this model a start should be made with the fuselage, using a straight strip.

thoroughly, except for the two surfaces where the wings and tail plane are to be attached. Drill a hole about 1/16-inch diameter through the nose. Aim at getting the wood as smooth and free from unevenness as possible. To do this, use the coarser glasspaper to work the wood to shape and the finer grade to smooth its surface.

The wings are made from ⅛-inch sheet balsa. If you have any choice of wood, pick the harder wood for the wings and a softer grade for the tail. Mark out the two wings as shown in Fig. 1D. If you draw ½-inch squares on the wood and follow the sketch you should get the shape correct. Make both wings exactly alike. If you cut away from the line on one, trim up the other to match it. Notice that the point of the wing tip is 1 inch back from the leading edge. This position is important later when balancing the finished model

Smoothing the Surfaces

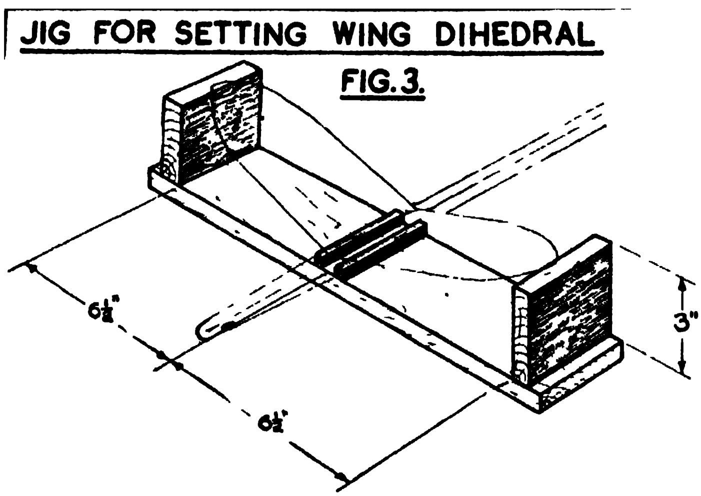
Next, carefully rub the wings down to the section shown in Fig. 1F, tapering the thickness towards the wing tip. The shape of this section is important as on its accuracy depend the flying qualities of your model. Draw a line along the top surface 1 inch back from the leading edge. This marks the thickest part of the wing, and you must work down from this each way, tapering to a thin edge at the rear and a thicker rounded edge at the front. The under-surface is kept flat. Finish off by making all the surfaces as smooth as possible

To locate accurately the wings on the fuselage you require a jig (Fig. 3). This is merely a support for the wings and fuselage to hold them while they are glued. It need only be quite roughly made, provided there are a couple of blocks in the middle to hold the fuselage upright and two blocks 3 inches high 6½ inches each side of the centre to hold the wings at the correct dihedral.

Fix the fuselage on the jig and rest the wings in position. You will see that the meeting ends of the wings need bevelling so that they rest against each other closely. To do this accurately, estimate the amount of bevel necessary, then rest the end of the wing over the edge of a table and work the bevel on it, using a piece of glasspaper wrapped round a flat block of wood. Do not try to do it with loose glasspaper held in the hand or you will spoil the work.

Before joining the parts together give the ends of the balsa wood wings a coating of balsa cement and allow it to dry. Then put the parts together with plenty of cement in the joint so that it forces out as the parts are pressed together. Leave the job an hour or so to set and then give the top surfaces round the joint another coating of cement to form a strengthening skin (Fig. 1B).

While this is setting you can make the tail plane and fin. Use 1/16-inch balsa and cut it to the outline shown (Figs. 1A and 1B). The exact shape is not so important as on wings, but try to get smooth curves and the two sides of the tailplane exactly alike. It is a good plan to cut a piece of cardboard to one of the curves and use it as a template for marking all three of them. Round off edges most carefully and smooth the surfaces.



The object of the jig is to locate the wings accurately.

Finally, before the glider is ready for its first trials, it has to be balanced. This is done by putting clay in the hole at the nose, adjusting the amount until the glider exactly balances when held lightly by a finger under the point of each wing tip. You may have to enlarge the hole to get sufficient clay in. This is best done by working it into an oval shape with a round file.

Cement the fin centrally on the tail plane, taking care that it is kept upright and not warped. Next, cement the whole tail unit to the fuselage, being careful to keep it true in relation to the wings. When you sight along the fuselage it should look like Fig. 1c.

Give the cement a chance to harden thoroughly by leaving the model overnight. Smooth it off with worn-out fine glasspaper and polish it all over. This may be done by lightly rubbing it with furniture polish, or by giving it several coats of model aeroplane dope, rubbing each coat smooth before applying the next. The perfect smoothness of its skin makes a lot of difference to the results you will get from your model.

For the first flight test hold the glider between the finger and thumb just below the wing, and launch it by throwing it gently forward parallel to the ground. Watch its behaviour carefully. If it dives at a steep angle the nose is too heavy. If it drops its tail after it leaves your hand the weight is not sufficient. When you have adjusted the weight so that the model glides smoothly at a shallow angle try hurling it into the air. Throw it upwards at a fairly steep angle. At the top of the throw the model should turn and roll, then settle into a steady glide. With a little practice you will be able to throw it to quite a good height, from which it will glide to earth in a most realistic manner.

Model Aeronautical Press Ltd

AN EXCITING CONTEST WITH MODEL AEROPLANES

In this picture members of the Yeovil and District Model Aeroplane Club are holding one of their interesting field events. The well-made models represent popular types of modern planes.

A 21-INCH SPAN RUBBER-DRIVEN AEROPLANE

THIS model, of the flying stick type, represents the simplest possible design of a flying model and is suitable for the beginner in aero-modelling. Despite its simplicity of construction it is quite a good flier, capable of flights of over a minute.

As you will see from Fig. 1, the fuselage is a square-sectioned stick, to which the other parts are fitted. The wire undercarriage is bent up to form skids which take the place of wheels, serving the purpose just as well and representing a saving in weight. The wing and tail unit are built up of balsa wood and covered with tissue. The list of materials at the end of this article gives the size of each part, the material from which it is made, and also its correct name. It is worth while memorising these names as they are the same for a model as for a full-size aeroplane.

All of the material may be purchased from a model shop. The propeller may be bought ready - made or partly finished, or you can carve your own. For a first attempt, however, it will probably be advisable to buy a ready-made propeller, reserving your attempts at carving one until you have gained some further experience.

Start with the fuselage (A), checking that the piece of wood is straight, and then making it smooth with glasspaper. Mark out the position of the slots for the undercarriage and cut them with a small saw, making these cuts very shallow. They need only be barely deep enough to take the wire (Fig. 2). The safest way to cut them is to draw the saw backwards across the line two or three times.

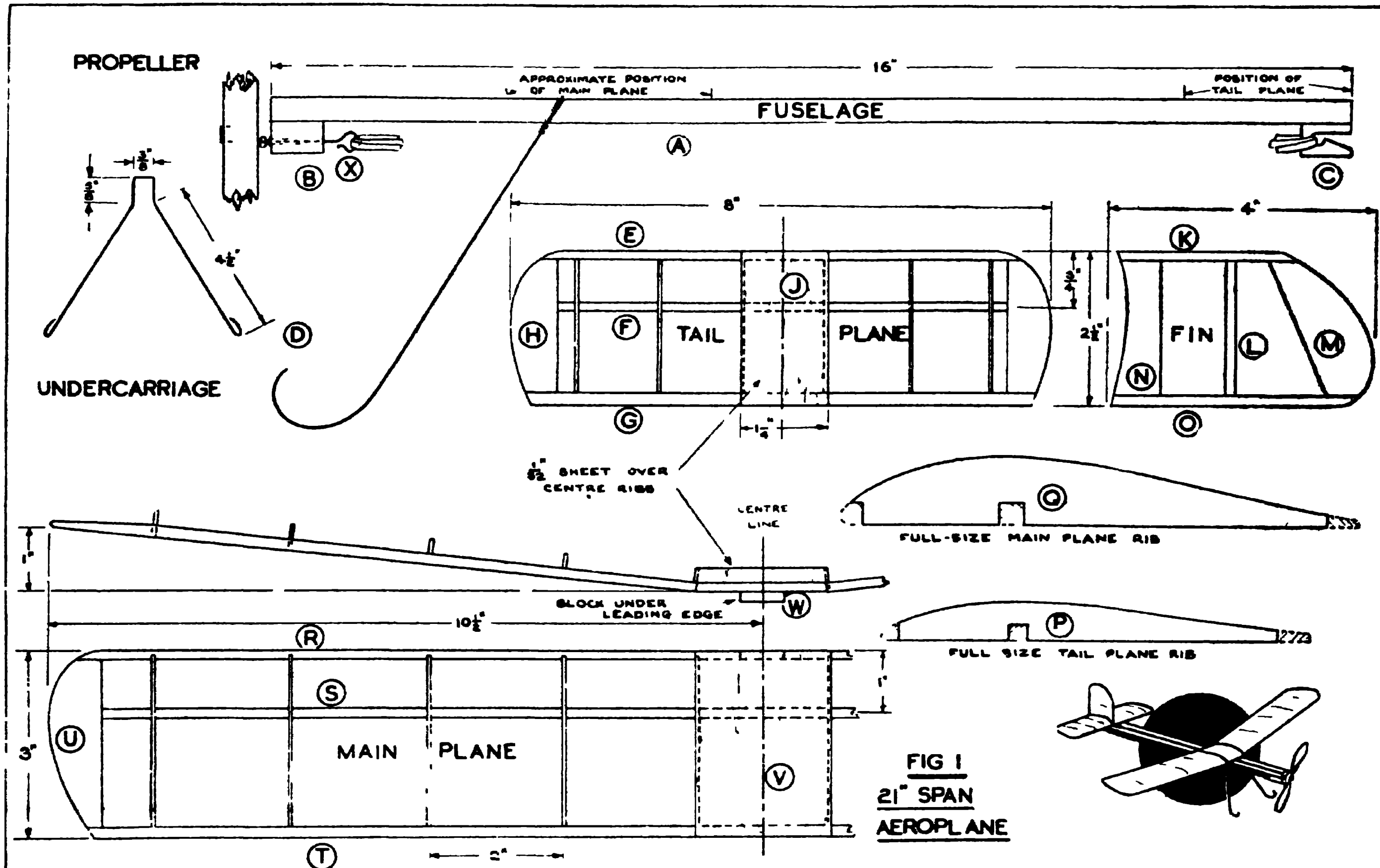
To make the tail skid (C) drill the hole and cut the slot before you reduce the piece to length, for then you will have sufficient wood to hold while working. The nose block (B) has to be drilled accurately to take the propeller axle. You can make a bradawl for drilling this out of a piece of the same wire as the axle, filed to a flat point at one end and fixed in a block of wood for a handle (Fig. 4). Glue blocks (B and C) to the fuselage with any good quality tube glue. All other joints in this model are made with balsa cement, which is particularly satisfactory for balsa wood, but is not suitable for the harder material used for the fuselage parts.

Making Fin and Planes

Before commencing to make the tail plane, fin and main plane, draw them full-size on a piece of paper fixed on a flat board. The drawings need not be very detailed, so long as you show the overall sizes and the position of each part.

Start with the fin, which is simplest of these three parts. Cut parts L, M and N accurately to shape with a razor blade. The leading and trailing edges K and O should be left a little on the long side. Lay the parts on the drawing, coat the joints with cement and press them together, holding them with pins pressed into the board (Fig 3). When the cement has set, trim the ends of parts K and O to shape and smooth the fin all over with glass-paper, slightly rounding the outer edges except the bottom, which will later be cemented to the tail plane. If the wood sticks to the drawing, it may be lifted by sliding a razor blade between wood and paper.

Cut one tail plane rib to the full-size drawing (P) and use it as a template for marking out five more. Cut the slot to fit snugly over the strip you have selected for the spar (F). Cut the tail plane tips (H) together so that they are exactly alike and make sure that they and the ribs are all of the same length. Cut the spar exactly to length, but allow a little extra on the ends of the leading and trailing edges (E and G). Place the spar (F) in place on the drawing and cement the ribs to it. Then cement the leading and trailing edges, cramping



COMPOSITE DIAGRAMS FOR THE RUBBER-DRIVEN AEROPLANE

This model which has a span of 21 inches is easily made with the aid of these pictures which run from 1A to 1X. This is the simplest possible design for a real flying model and is quite suitable for a beginner to undertake

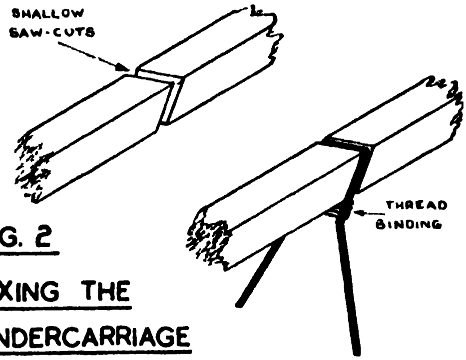


FIG. 2
FIXING THE UNDERCARRIAGE

The safest way to make these cuts is to draw the saw backwards across the line

them with pins in exactly the same way as you did the fin. Add the tips (H) and leave the cement to dry. When it has set, clean the structure up with glasspaper, paying particular attention to the smoothness of the curve over the tops of the ribs. Cut a piece of $\frac{1}{32}$ inch sheet balsa to fit over the tops of the two centre ribs and cement it in position, weighting it if necessary while the cement sets.

The wing, or main plane, is made up of three parts: two outer planes and a centre section. The joints are made at the two ribs each side of the centre-line. Cut the ribs in the same way as for the tail plane, using the first one (Q) to mark out the other nine. First form the two outer planes, building them up and cramping them with pins as you did the tail plane. Be careful to make a pair and not two of the same way. After they have set, cut the inner ends of pieces R, S and T flush with the inner ribs.

Cut the parts of pieces R, S and T which form the centre section 2 inches long and bevel their ends slightly. You can get this bevel accurately if you place each strip in turn over the front view of the centre section in Fig. 1 and cut straight down with a razor blade over the line of the rib.

Making the Jig

So that you can get the main plane correctly assembled with equal dihedral at each side, build up a simple jig, similar to the one described for the 14-inch glider, in the following way: On a flat board, draw two lines $20\frac{1}{2}$ inches apart and another midway between them. Stand two blocks 1 inch high against the outer lines. Cement the three strips forming the centre section in place between the two outer planes, while they are resting on the jig. Arrange the parts so that the wing tips are resting on the blocks at the ends of the jig and the centre section is set equally on each side of the centre-line. Use plenty of cement at the centre section joints and cramp the wing to the jig with pins. Cement a piece of $\frac{1}{32}$-inch sheet over the centre ribs, but do not, at this stage, fix piece W.

When all parts have been smoothed and their edges rounded they are ready for covering with tissue, which is fixed with ordinary paste. Do not attempt to cover, say, the whole wing

CRAMPING WHILE GLUEING

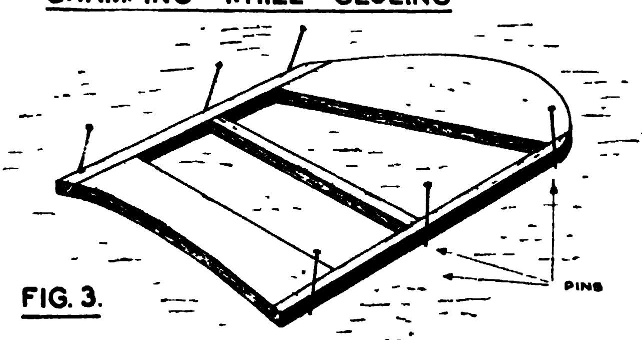


FIG. 3.

When the joints have been coated with cement and pressed together, use pins to hold them

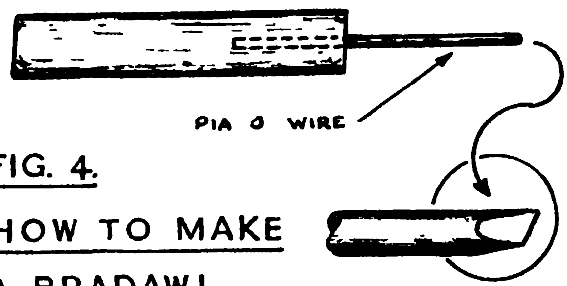


FIG. 4.
HOW TO MAKE A BRADAWL

This home-made bradawl is formed of piano wire. It will be useful for most modelling.

with one piece of tissue, but use one piece over the top and bottom of each outer plane and one piece round the centre section. Cut each piece with a little overlap, then cover the wood with paste and fix the tissue in position, keeping it as tight and smooth as possible, although there is no need to strain it too hard, as the final tightening will be carried out by steaming and doping.

Allow the paste to dry thoroughly, this taking about twenty-four hours. Then pass each tissue-covered surface through a jet of steam coming from a kettle. The purpose of this is to moisten the paper, but it must not be saturated, so you ought not to allow the steam to play too long on the paper. Put the parts aside; and when they have dried, you will find that the paper has become drum-tight. The paper could be left like this, but in damp weather you might find that it would become limp, so to waterproof it you must give it a coat of clear dope. This is applied with a brush, going over each part once only and not attempting to work the dope into the paper.

The piano wire used for the undercarriage and propeller axle is very hard springy steel, but it can be bent by holding with pliers and coaxing round with the fingers. Make up your mind how a bend is to go—then force it there. This wire will not stand bending one way and back again, for then it would break. Bend the undercarriage to shape, keeping the two sides as evenly balanced as possible. Slip it into the slots on the fuselage and fix it there by tying the two sides together under the fuselage with thread, which is finally coated with cement (Fig. 2).

The end of the propeller axle is bent into a loop to take the rubber motor. This is most easily made, using flat pliers, by keeping the sides of the square the same as the width of the plier nose, and working back from the end of the wire. Pass the axle through the fuselage nose block, thread on three cup washers and then the propeller. Cut off the end of the wire and turn it back into the propeller, fixing it there with a spot of cement.

Making a Propeller

If you decide to make the propeller, select a piece of wood without flaws and as evenly grained as possible. Red deal, yellow pine and spruce are all suitable. Choose a piece in which there is no great difference in the colour of the grain. This indicates that the wood is "mild" and will work easily. Balsa wood can be used for propellers; but, although it is easy to work, it is not very strong and a balsa propeller will not survive many crashes.

Before carving, the block should measure $7\frac{1}{2}$ inches long, 1 inch wide and $\frac{3}{8}$ inch thick (Fig. 6). At exactly half the length mark a line with a pencil and try-square round all four faces of the wood (i). Mark the centre, back and front, and drill a hole for the wire shaft, working from each side so as to keep the hole true, and employing the same bradawl (Fig. 4) as you used for the nose block.

Mark out the wood as indicated (ii). To show the marking on all surfaces

the four sides and the two ends have been imagined to be unwrapped, as it were, and spread out flat. The wide face with the $\frac{1}{4}$ inch marks on the corners will be the front of the propeller. Draw the lines on the ends and join the dots on the front and back with free-hand lines, making the curves as smooth as possible (iii). Scribble on the waste wood. This completes the marking out and the block should appear as at (iv).

Fix the block edgeways in a vice and saw down the centre-line as far as the propeller line on each side. Carefully chisel away the waste down to the saw-cut following the outer curve of the propeller marked on one of the faces (v). Turn the wood over and repeat at the other side (vi). Now, with a wide chisel cut away some of the waste on each side near the ends, working towards the ends and carefully down to the lines marked on them (vii).

The next step is the most important as on it depends the accuracy and efficiency, or otherwise, of your propeller. With the propeller held in a vice, and one end projecting, carefully work away the waste until at every point the surface is straight when checked with a rule. This can be done partly with a chisel, used bevel-undermost, and partly with a file. Do not try to curve the propeller but merely concentrate on getting each surface flat laterally (viii).

Shape both ends. Do not bevel too far back, otherwise you will take away some of the area which is most useful in providing "lift" (ix). At this point you can start testing balance, by supporting the propeller on a pin and seeing if each blade always swings to the bottom. If the unevenness is only slight, do not bother about it for a time; but, if it is much, try to even it up by taking a little more off the tip of the heavy blade, or by thinning its tip slightly.

Balancing the Blades

Finally, with a file and glasspaper, round off all edges and, except at the centre, rub the remaining edges of the $\frac{1}{4}$-inch front and $\frac{1}{8}$-inch back down into smooth shapes. Aim at getting an aerofoil section with a flat under-surface (x). Balance the blades by carefully working down the tip of the heavier one.

Cement the fin to the centre of the tail plane and fix the small incidence block (W) under the leading edge of the centre section. Attach the wing and tail unit to the fuselage with rubber bands (Fig. 5). The approximate position of the wing is shown in Fig. 1, but its exact location must be fixed later during the flying trials.

For power you need a strip of rubber of $\frac{1}{8} \times \frac{1}{20}$ inch section 90 inches long. This should be passed round the hook on the propeller axle and tail skid, the ends being joined with a reef knot, so as to form a 6-strand motor. If the rubber is coated with rubber lubricant (from the model shop) it will stand more winding and consequently give a longer duration of flight.

For the first flying test do not wind the rubber, but use the model as a glider. Hold the fuselage just behind the undercarriage and throw the plane gently forward. If it dives steeply, advance the wing. If it drops its tail as it leaves the hand and then spirals, move the wing back. Next give the

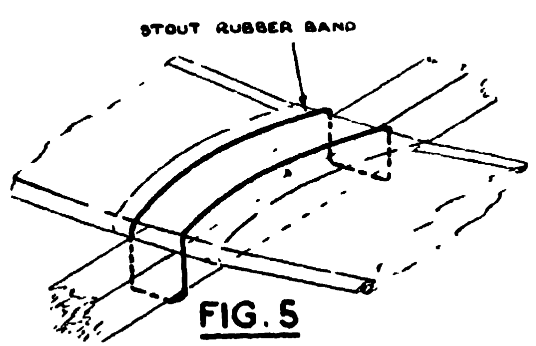


FIG. 5

FIXING MAIN AND TAIL PLANES

should be noted that the exact location of the wing is found during trial flights.

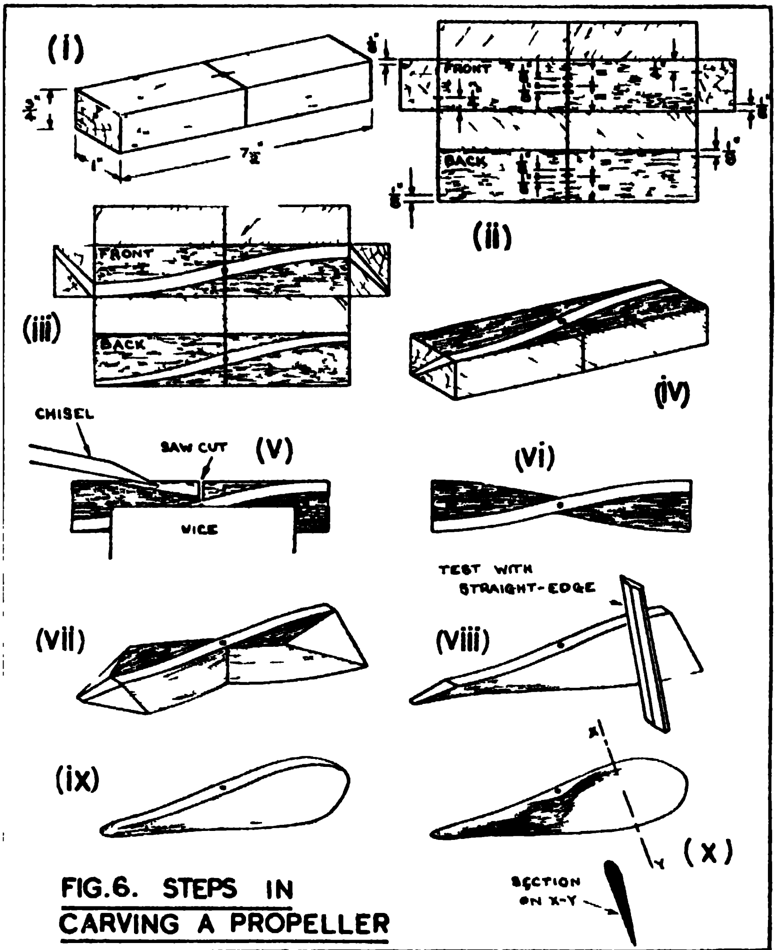


FIG.6. STEPS IN CARVING A PROPELLER

You may wish to make propellers for some of your model aeroplanes and this series of working diagrams shows you how the work can best be carried out

propeller about 50 turns and hand launch the model in the following way

Hold it as before with one hand and steady the propeller with the other Release the propeller just a moment before throwing the model forward Watch its behaviour and trim the wing forward or back a little until the model flies level These tests can be made in a large room, but when you have completed trimming take the model out of doors, give its motor the maximum number of turns (about 700, depending on the rubber) and launch it into the blue It should then climb steadily until the motor runs down and completes its flight with a long shallow glide back to earth

LIST OF MATERIALS

Part	Name	Material	Sizes
A	Fuselage	Deal pine or spruce	3/8 square
B	Nose block		1/2 × 1/2"
C	Tail skid		1/8 × 3/8
D	Undercarriage	Piano wire	20 gauge
	Tail plane		
E	Leading edge	Balsa	1/8 square
F	Spar		1/8 square
G	Trailing edge		3/16 × 1/16"
H	Tip		1/16" sheet
J	Centre section	,,	1/32" sheet
	Fin—		
K	Leading edge	.	3/32" square
L	Rib .	, .	3/32" square
M	Tip	,,	1/16" sheet
N	Base	,, .	1/16" sheet
O	Trailing edge	Balsa	3/32 square
P	Tail plane rib		1/16" sheet
	Main plane		
Q	Rib		1/16" sheet
R	Leading edge		1/8 square
S	Spar		1/8" square
T	Trailing edge		1/16 × 1/16"
U	Tip		1/16" sheet
V	Centre section		1/32" sheet
W	Incidence block	,,	1/8" square
X	Propeller axle	Piano wire .	20 gauge
	Washers .	Cup washers (3) to fit axle	
	Propeller	7½" diameter, medium pitch	
	Motor . .	1/8" × 1/20" rubber, 90" long	

A 36-INCH SPAN TOW-LAUNCHED GLIDER

THIS glider may be hand-launched in the same way as the simpler 14-inch span glider, but it is really designed for tow-launching, *i.e.*, launching from the end of a tow-line which assists it to soar to a considerable height before releasing itself from the line. In this way the glider starts its flight from a more favourable position and will glide further and for a longer period than if hand-launched.

The construction is very similar to that of the 21-inch span aeroplane, except that a built-up fuselage is used instead of the plain stick, this fuselage being of the diamond type. It is square in cross-section, but the square is turned up on edge. The whole of the model, except for the fuselage, formers and tow-hook, is made of balsa, covered with tissue. The list of materials at the end of this article shows what is required, whilst Fig. 1 gives the sizes of the parts.

Start by making a full-size drawing of the fuselage, tail plane, fin, centre section and outer plane. When drawing the fuselage, put in the centre-line first and draw lines across it to show the positions of the struts. Mark off the lengths of those dimensioned in Fig. 1. Notice that at the tail the longerons meet at a point. Bend a rule through the points so far marked and get someone to run a pencil along the rule while you hold it in position. Make sure that the lines of the longerons are equally arranged above and below the centre-line.

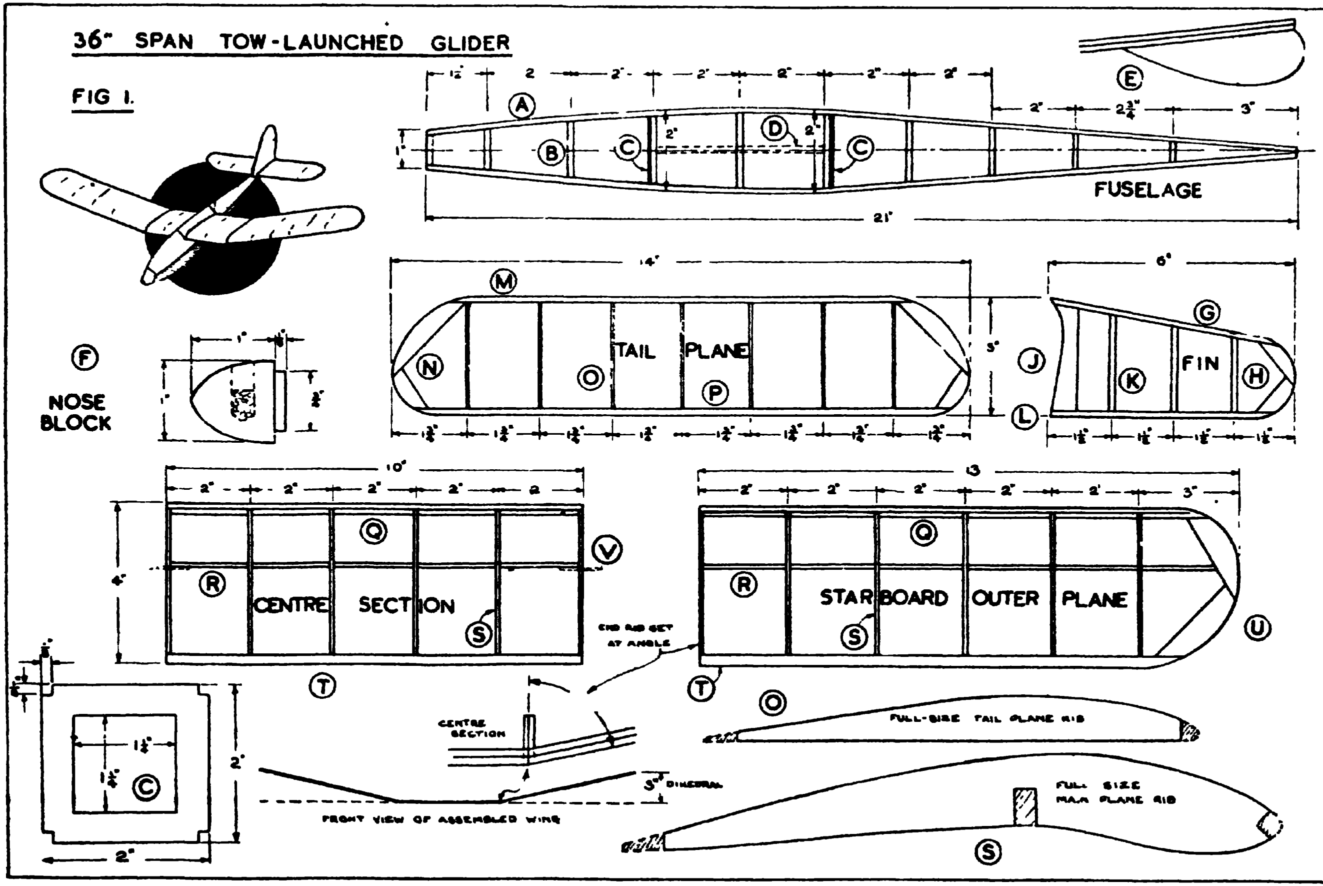
The fin and tail plane are constructed as in the last model. Cut one rib to the full-size pattern (O) and use it to mark out the other six. Cut them all exactly alike, and hold them side by side while you glasspaper their tops to the same curve. The tips (N and H) are cut in two pieces so that the grain roughly follows the curve, giving strength with lightness. Cut the underside of the fin (J) to fit over the centre rib of the tail plane. Assemble and cement the parts on the drawing, holding them with pins as before.

The wing has a wide centre-section to which the outer planes are attached. The ribs have curved undersides (S). This shape is a little more difficult to cut than a flat-bottomed rib, but a wing with this section has better lifting qualities, when used in a comparatively slow-flying model, than one with a flat undersurface. Make up the centre-section on the drawing, fixing all the ribs upright on the spar (R) before cementing on the leading and trailing edges. The leading edge strip is fixed edgeways in the slots in the noses of the ribs.

Making the Outer Planes

Make up a pair of outer planes in the same way, but set the inner ribs at the angle shown in Fig. 1. This is done so that the outer planes will have the correct dihedral when the whole wing is assembled. Round off the front of the leading edge and cut the ends of the strips flush with the outsides of the joining ribs on all three parts. There is no need to make a jig for fixing the dihedral of the wing. All you need are two blocks or boxes 3 inches high. Use plenty of cement on the joining ribs and put the three parts of the wing together, supporting the wing tips on the 3-inch blocks. Cramp the joints with wire paper clips. Strengthen the job, after the cement has set, by cutting a groove through the joined ribs alongside the spars and cementing in a slip of $\frac{1}{32}$-inch plywood, 1 inch long (V).

The fuselage, when first built, has all four sides exactly alike. The longerons have only a slight curve and there should be no difficulty in bending them. Make up two sides exactly as in the drawing, ignoring parts C and D for the moment. A side should be built up in steps, starting either from the nose or from the longest struts, cramping the joints with pins at each step



A SERIES OF WORKING DIAGRAMS WHEN MODELLING THE LARGE GLIDER

This is a much more ambitious glider than the one first described. It may be hand-launched, though really designed for tow-launching. All the necessary measurements are given above. In the top left-hand corner is a sketch of the finished model.

Cut two fuselage formers (C) from $\frac{1}{32}$-inch plywood. These are used to keep the fuselage shape true, as well as to strengthen it. When you have made up two fuselage sides, cut two more sets of struts, *i.e.*, for each strut in one side cut two more the same length.

Stand the two fuselage sides on edge and cement the two fuselage formers (C) between them in the positions shown. Fix the other struts opposite the existing struts. You cannot cramp the joints with pins as the fuselage is curved both ways ; but you may secure them by slipping rubber bands round the fuselage, being careful not to let the fuselage twist. The formers will keep the cross-section accurate, but the parts may slip out of shape lengthways or all the squares may not line up with each other when viewed end-on. Any fault like this should be corrected before the cement sets.

Select one longeron to form the top of the fuselage, and cut it away between the struts cemented to the formers. Also cut away half of the two struts on each side of the cut longeron, and fix two centre section bearers (D). These two bearers should be parallel and level (Fig. 2), as the centre section has to fit snugly down on them. At the tail, cut away the top longeron as far as the first struts so that the two side longerons form the tail plane bearers (Fig. 3). Cut a piece of $\frac{1}{16}$-inch balsa to form the tail skid (E) and cement it to the bottom longeron.

Before covering the parts, the combined front skid and towing hook should be bent up with pliers and fixed to the bottom longeron by a thread binding covered with cement (Fig. 4).

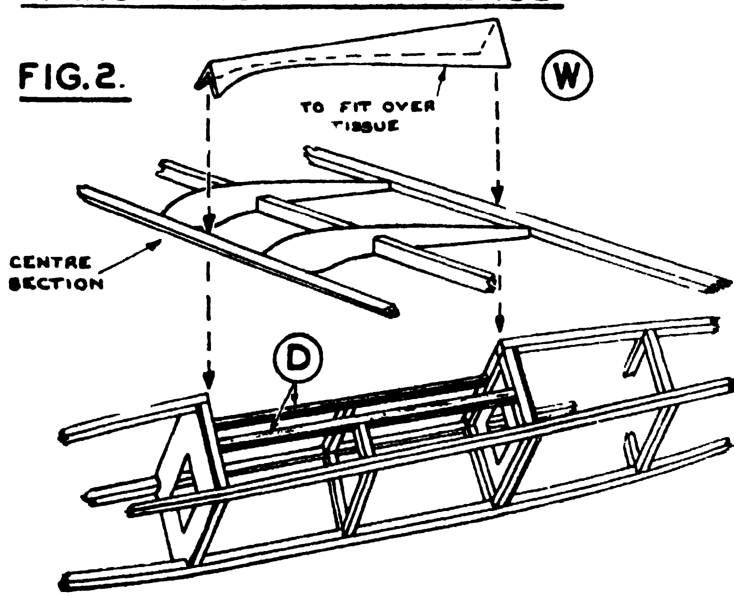
The Dope to Use

Cover all the parts with tissue, tensioning it by steaming and doping as described for the last model. Use clear tightening dope. Coloured dope is too heavy to be applied all over the model, but if you like to use a bright colour on the part of the fuselage forward of the wing you can do so without spoiling the model's flying qualities.

Put the wing in position in the slot and make a fairing (W, Fig. 2) to fit above it and carry on the line of the fuselage. The best way to do this is to make one in paper first, trimming it accurately to fill the space, and then using it as a template to mark out two

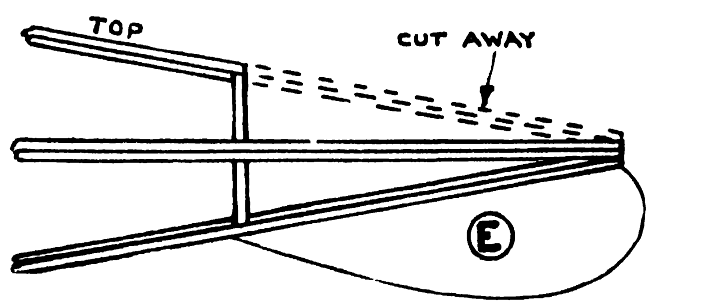
FIXING WING TO FUSELAGE

FIG. 2.



The piece which carries on the line of the fuselage is known as a fairing A template should first be made in paper.

FIG. 3. TAIL END OF FUSELAGE



This diagram explains exactly how the two side longerons form the tail plane bearers

centre of the other end of the block and file it into shape Glue the block in the fuselage nose with the hole upwards (Fig 5)

To balance the model, support it lightly at the wing tips, with the fingers opposite the ends of the spar, and add lead weights or pellets to the hole until a balance is secured Plug the hole with a bit of round rod but do not fix it permanently as you will probably have to alter the weight slightly when you flight test the model Make your first tests by hand launching the glider towards some soft grass or a carpet If it dives steeply remove some of the weight If it falls or drops its tail as it leaves your hand, increase the weights

pieces of 1/32-inch balsa which are cemented to each other and to the wing

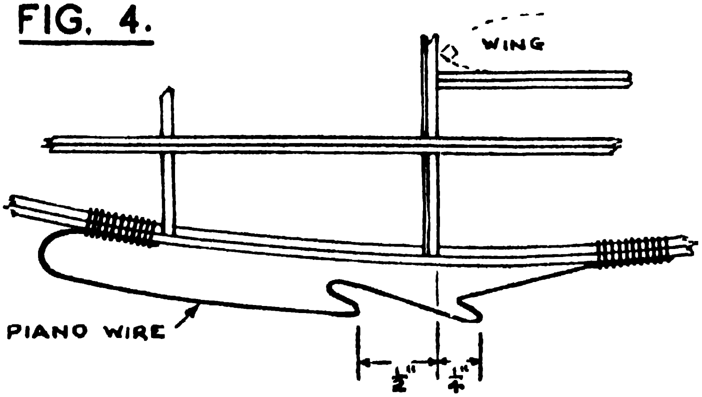
Cement the fin to the tail plane, and either cement the tail plane to the fuselage or fix it with a rubber band Fix the wing with a rubber band passed over the top surface on each side of the fairing and under the fuselage

Make the nose block (F) from a 1 inch square piece of wood Before shaping it, drill a 3/8-inch hole about 1/4 inch deep This should be drilled cornerways, if you can manage it, but it is easier to drill it at right angles to a surface, and it does not make any difference that way, except in appearance Cut back one end to 3/4-inch square, or cement on a 3/4-inch square piece of 1/8-inch wood. This square should fit closely into the nose of the fuselage Mark the

For your first tow line, use a piece of

WIRE TOWING HOOKS & SKID

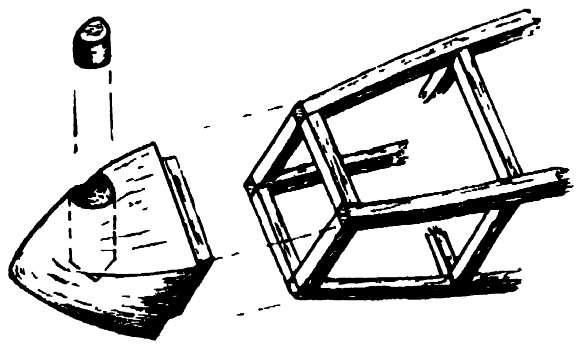
FIG. 4.



Make your towing hook very carefully with the aid of pliers noting that it also forms the front skid

stout thread about 50 feet long. You can experiment with longer lines later. At one end tie a small metal or bone curtain ring, of a size that will loosely fit over the towing hook. Use the forward hook for your practice flights. The other hook will give you greater height, when you have gained some experience with the tow-line, but even then it is more difficult to manage. However, one of the great attractions of model flying is the amount of experimenting which you can carry out yourself; and as you try various weights or lengths and positions of the tow-line you will find conditions which suit your particular model and so obtain improved flights.

FIG. 5. FIXING NOSE BLOCK



Observe that the square formed at the back of the nose should fit snugly into the end of the fuselage

To launch the glider from the tow-line, lay out the line on the ground with the ring down-wind. Hook the glider to the ring and get an assistant to hold it just below the wing. Hold the other end of the line and run into the wind. The assistant releases the glider as soon as the line begins to pull. There is no need to race, but you should run fairly quickly at first and then slow down after a few steps. The model will soar upwards, like a kite; and, as it gets to a good height, the tow-line will drop off, leaving the model to commence its glide. With practice you will be able to "play" the glider up to the maximum height that the line will reach, and so get the longest possible glide

LIST OF MATERIALS

Part	*Name.*	*Material*	*Sizes.*
	Fuselage		
A	Longeron . .	Balsa .	$\frac{1}{8}''$ square
B	Struts . .	,, .	$\frac{1}{8}''$ square
C	Fuselage former .	Plywood .	$\frac{1}{32}''$ thick
D	Centre section bearer.	Balsa .	$\frac{1}{8}''$ square
E	Tail skid . .	,, .	$\frac{1}{16}''$ sheet
F	Nose block .	,, .	1″ square
	Fin —		
G	Leading edge	,	$\frac{1}{8}''$ square
H	Tip . .	,, .	$\frac{1}{16}''$ sheet
J	Base . .	,,	$\frac{1}{16}''$ sheet
K	Rib . . .	,, .	$\frac{1}{8}''$ square
L	Trailing edge .	,, .	$\frac{3}{16}'' \times \frac{1}{16}''$

Part.	*Name*	*Material.*	*Sizes*
	Tail plane —		
M	Leading edge	Balsa	$\frac{1}{8}$ square
N	Tip . .	, .	$\frac{1}{16}''$ sheet
O	Rib . . .	, .	$\frac{1}{16}''$ sheet
P	Trailing edge .	,	$\frac{1}{16}''$ $\frac{1}{16}$
	Centre section and outer planes		
Q	Leading edge	,, .	$\frac{1}{8}''$ square
R	Spar . . .	, .	$\frac{1}{8}$ square
S	Rib . .		$\frac{1}{16}''$ sheet
T	Trailing edge		$\frac{1}{4} \times \frac{1}{16}''$
U	Tip . .	.	$\frac{1}{16}''$ sheet
V	Dihedral brace	Plywood	$\frac{1}{32}$ thick
W	Fairing . .	,, .	$\frac{1}{32}''$ sheet

A HIGH-WING CABIN MONOPLANE

THIS model has a most realistic appearance, being very similar to many popular types of full-size light aircraft. Its construction is straightforward, and anyone who has made one of the models described in earlier pages should find it easy to build. It ought not, however, to be attempted as a first model.

The wings and tail unit follow closely along the lines of the previous designs. The fuselage has a box section, which encloses the rubber motor. The undercarriage wheels allow the plane to take off from a smooth floor. The propeller is fitted with a simple free-wheel device which permits it to spin freely after the motor has run down, thus lessening the resistance to the airflow and increasing the length of the final glide.

Commence by making a full-size drawing of the principal parts. Fig. 1, except where marked otherwise, is drawn to a scale of ¼ full-size, so to obtain any length which is not marked you should measure its length on the drawing and multiply it by four to arrive at the actual model size. Be careful when drawing the top view of the fuselage to get the two curves equal on each side of the centre-line.

The construction of fin and tailplane is almost the same as with the earlier models. The tail plane ribs are not shaped before assembly, but the top surfaces are rubbed down to a slight curve with glasspaper after they have been cemented in position. Round off the leading edges, but do not cement the fin in place until after the surfaces have been covered.

The main plane has double spars (Y), which are a little complicated to fit, but make a very stiff wing. It is sometimes difficult to prevent a lightly braced wing from warping, and the second spar helps in keeping the outer plane true. Make up each outer plane in the usual way, fixing the ribs (V) to the bottom spar and then adding the top spar and the leading and trailing edges (X and Z). At the outer rib, notch the top spar underneath and bevel its end so that it can be bent down to the wing tip. Cut the inner ends of the leading and trailing edges and the bottom spar flush with the inner ribs, but let the upper spar project ¾ inch.

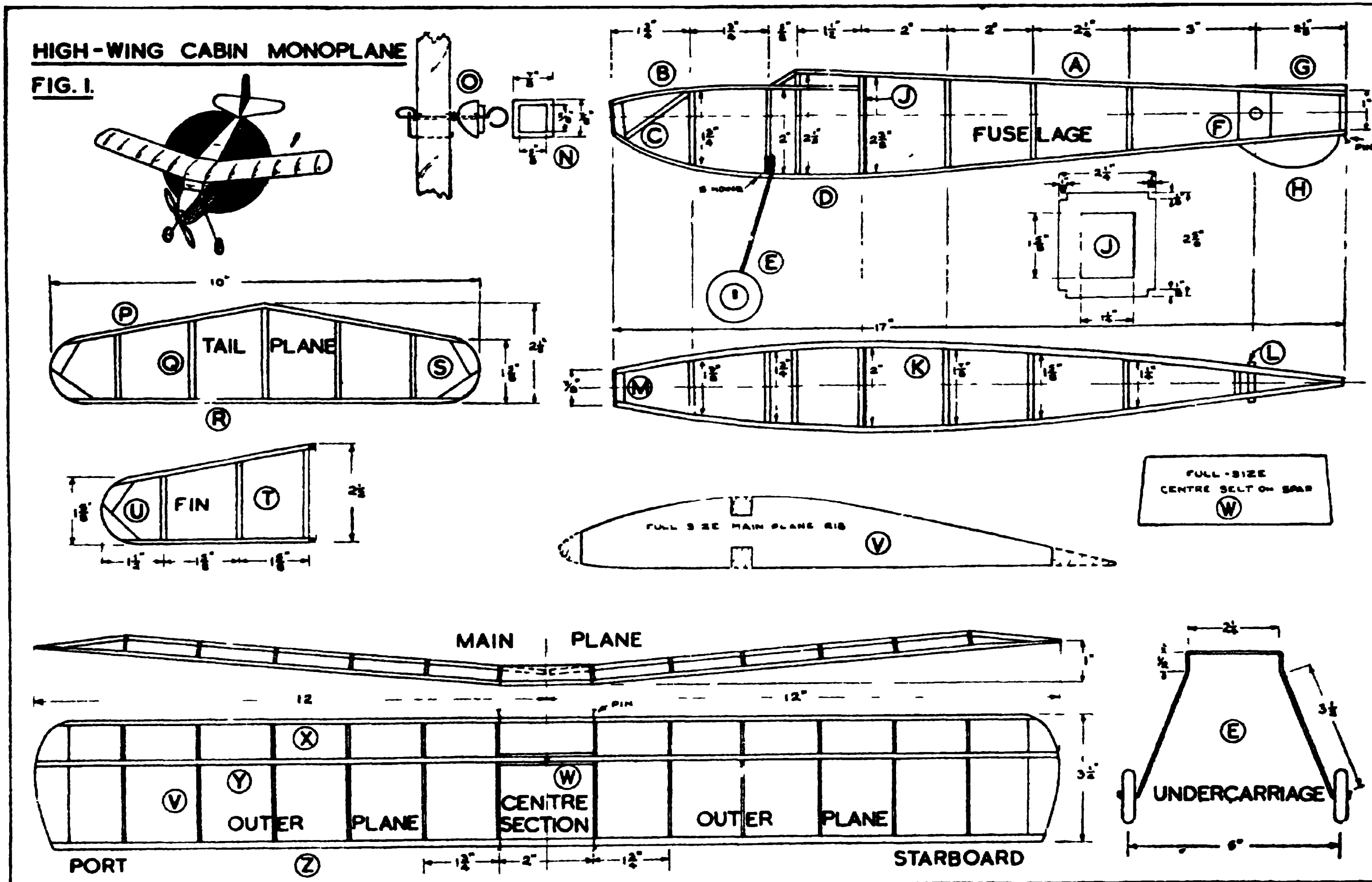
Cut the two centre-section spar sides (W) from $\frac{1}{32}$-inch plywood and cement them each side of the projecting upper spar ends while the wing tips are supported on 1-inch blocks. Fix short lengths of leading and trailing edge in position and cramp the whole framework with pins (Fig. 2).

Making the Fuselage

Select good pieces of fairly hard balsa for the fuselage longerons (A), building two sides exactly alike over the drawing. Notice that the nose end of the fuselage is not exactly upright, but has a slight downward tilt. The curve of the bottom longeron is fairly sharp under the nose, but the strip may be bent to shape in the following manner: Fix all the other parts in position on the drawing, and cement the lower longeron to the bottom of the nose strut first, cramping it with a pin. Work back towards the tail, cementing and pinning at each strut in turn.

When both sides have been completed, join them with the cross-struts, starting at the thickest part, just aft of the cabin. Fix the $\frac{1}{32}$-inch plywood former (J) and cramp the whole assembly with rubber bands until the cement dries. At the tail, fit the two tapered tail plane bearers (G) to the top longeron, and the tail skid (H) midway between the bottom longerons. Push a small pin into the tail aft of the tail skid, to hold the tail-fixing rubber band.

The undercarriage is made of a single piece of 20 gauge piano wire 12 inches long (E). Bend it to shape with pliers, making the width across the top the same as the fuselage width at



THESE DIAGRAMS REFER TO OUR ATTRACTIVE MODEL MONOPLANE

The small sketch in the top left-hand corner gives an excellent idea of the finished model, which has a most realistic appearance. It ought not to be attempted as a first model

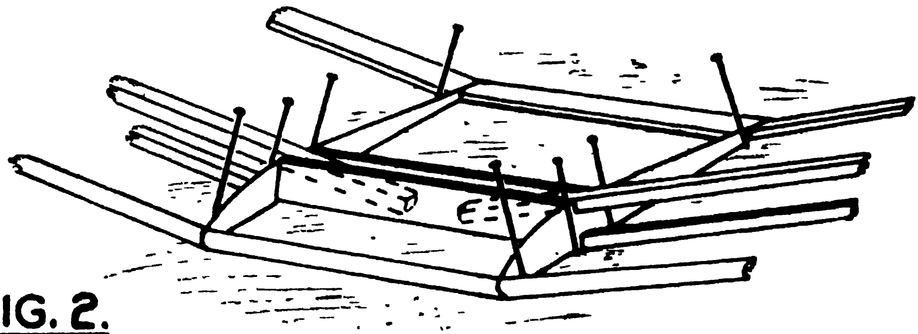


FIG. 2.

CRAMPING THE CENTRE-SECTION

When the short lengths of leading and trailing edge are in position they should be cramped with pins

the point where it is to be fitted ($2\frac{1}{4}$ inches). The wheels should be purchased ready-made, unless you have a lathe, in which case you could turn them $1\frac{1}{4}$ inch diameter.

The nose block (O) may be filed and glass-papered to shape from a solid block of balsa or from one built up from several sheets. If you build up the block, which is then called a laminated block, cement the sheets with their grain at right-angles to each other. Drill the block to take a piece of brass tubing which forms the bearing for the propeller axle (Fig. 3). The back of the block should fit in the fuselage nose. To strengthen this part, cut a piece of $\frac{1}{32}$-inch plywood (N) to fit the block, and cement it to the front of the fuselage. Do not cement the nose block to the fuselage.

The propeller may be bought ready-made or you can carve it yourself in the same way as the propeller for the simpler model. (See p. 335.) Instead of the block as described in that article, use one $8\frac{1}{2} \times 1\frac{1}{8} \times \frac{3}{4}$ inches. Except for these differences in over-all sizes, the other dimensions and the method of carving are exactly the same. The hole through the centre of the propeller should be an easy fit on the wire used for the axle, but it ought not to be so loose that the propeller wobbles.

A Free-Wheel Clutch

To make the axle, bend up the motor loop with pliers, then slip the wire through the nose block bearing, fit three cup washers, and slide on the propeller. Bend the end of the wire into a long loop as shown (Fig. 3). Fix another short wire through an easy-fitting hole in the propeller about $\frac{3}{8}$ inch away from the centre. Bend over the back of this wire to prevent it slipping out, and turn down the front so that it lies across the axle loop. Cut it off so that when the loop is turned away from it, its end lies midway between the two sides of the loop. This wire forms the free-wheel clutch.

Cover the parts with jap tissue, tensioning it with steam and clear dope in the same way as with the previous models. Leave the space between the tail plane bearers uncovered, so that you can reach and fix the rear end of the rubber motor to the motor peg (L). To give a more realistic appearance, cover the part round the front and sides of the cockpit with clear cellophane or thin celluloid.

The main plane should be fixed to the fuselage with two rubber bands and four pins. Push the pins into the four corners of the centre-section and pass the two bands round the fuselage. Fasten the wing by slipping the pin

heads under the rubber bands. The correct position of the wing is with its leading edge a little way aft of the front of the cockpit roof. Fix the tail plane with a single rubber band passed under the fuselage forward of the tail plane, over its upper surface each side of the fin and down to the pin behind the tail skid.

For the motor you need 5 feet of $\frac{1}{8} \times \frac{1}{16}$ inch rubber. Bend this up to form three loops, and tie the ends with a reef knot. The motor is longer than the distance between the two points of attachment, but this is intentional as it enables the rubber to be given a greater number of turns. It is a good plan to put a piece of cycle valve rubber over the loop on the propeller axle to minimise wear on the motor. Treating the rubber with special lubricant is an advantage, but you must obtain the correct lubricant from a model shop. Do not use ordinary machine oil as this is injurious to the rubber.

The easiest way in which to fit the rubber is to attach it to the hook on the propeller axle and tie a piece of string to the other end. Weight the string by tying a knot in it, then hold the fuselage, without the tail plane, vertically; and lower the string through it until you can grasp its end between the tail plane bearers. Pull the rubber through, push the peg (L) between the strands, and remove the string.

Testing the Model

Try the model first as a glider, and adjust the position of the wings until the correct trim is found. For an initial power test, engage the free-wheel, give the motor about 100 turns, and hand-launch it. If this is satisfactory try a greater number of turns and allow the model to take off under its own power from the ground. It will only do so from a smooth hard surface and it is no use trying to bring about the movement on grass or earth. A runway of boards is most convenient.

It is very tedious putting on a large number of turns directly by hand, and some sort of gearing is desirable. A common device used for this purpose is an engineer's hand drill carrying a wire hook which is engaged with the loop on the front of the propeller axle (Fig. 4A). This has a gear ratio of about six to one, so for each turn of its handle the rubber motor is given some six turns (you can find the exact number for a particular drill by counting the number of times the propeller axle turns for one turn of the drill handle).

Another type of winder is shown in

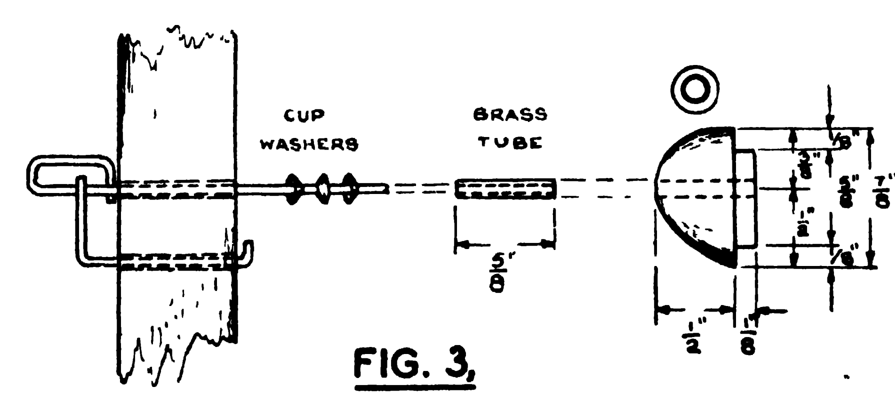
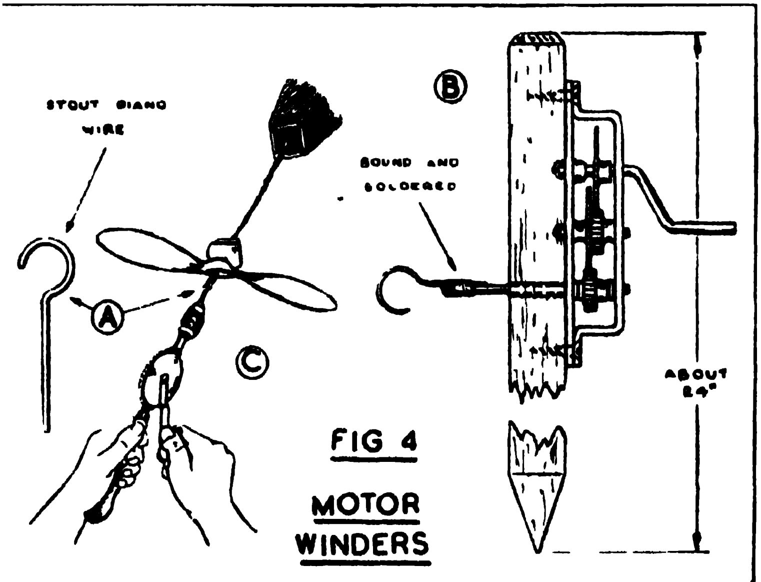


FIG. 3,

THE PARTS OF THE PROPELLER ASSEMBLY

It will be noted that the block has a piece of brass tubing to form the bearing for the propeller axle



Model aeroplane winders may be made from cogs taken from an old clock
Make the hook from piano wire

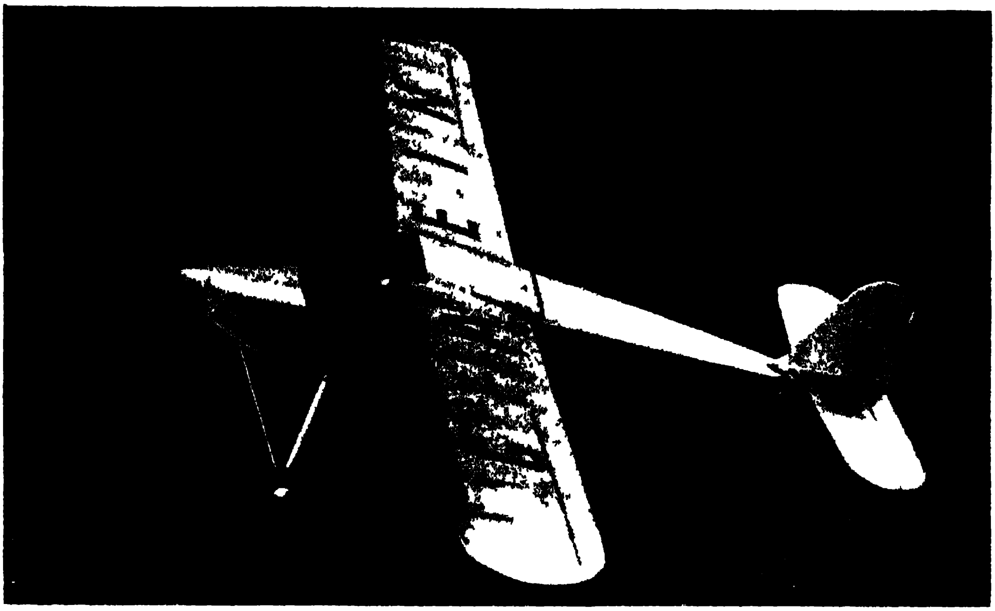
Fig. 4 This can be built up from cogs taken from an old clock, or suitable parts may be bought from a model shop. The gearing is mounted on axles supported in a frame made from two pieces of $\frac{1}{2} \times \frac{1}{8}$ inch strip iron. The whole apparatus is screwed to a post which can be pushed into the ground. The sizes of your winder, and its gear ratio, depend on what cogs you obtain That shown in the sketch has a gear ratio of nine to one; the propeller being turned nine times for every turn of the handle. This is brought about by having the cog on the handle axle three times the size of the one it drives, and the other cog on the centre axle three times the size of the one on the hook axle. The hook is made from piano wire and is bound with thin wire to the axle, then soldered.

You can obtain a greater number of turns on this, or any other rubber driven model, if the motor is stretch-wound To do this, get an assistant to hold the model while you pull the propeller and nose block forward, and commence twisting the rubber with a winder (Fig. 4C) As the number of turns increases, allow the rubber to shorten until the nose block is back in position in the fuselage.

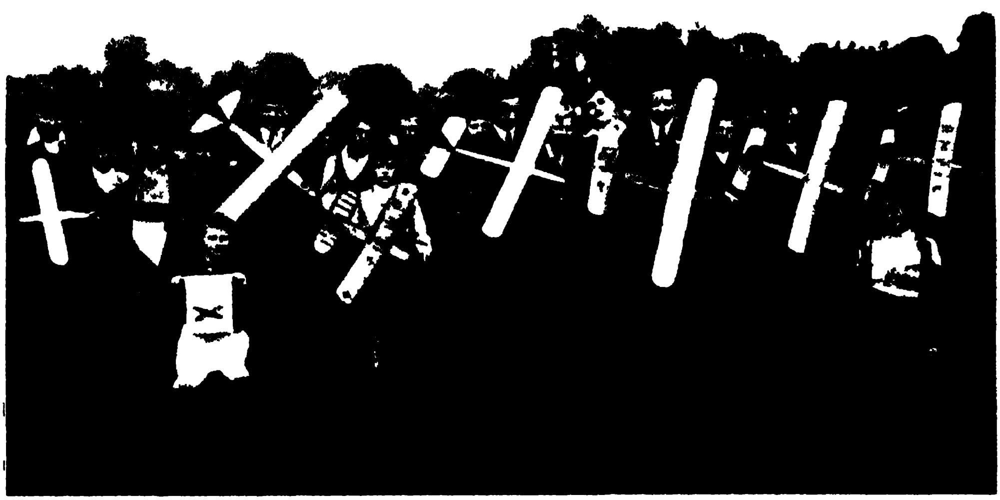
LIST OF MATERIALS

Part.	*Name.*	*Material*	*Sizes*	*Part.*	*Name.*	*Material*	*Sizes*
	Fuselage—				**Tail Plane and Fin -**		
A	Top longeron	Balsa	$\frac{1}{8}$" square	**P**	Leading and trailing edges.	Balsa	$\frac{1}{8}$" square
B	Front longeron	,,	$\frac{1}{8}$" square	**Q**	Rib	,,	$\frac{1}{8}$" square
C	Brace	,,	$\frac{1}{8}$" square	**S**	Tip	,,	$\frac{1}{16}$" sheet
D	Bottom longeron	,,	$\frac{1}{8}$" square	**T**	Rib	,,	$\frac{1}{8}$" square
E	Undercarriage	Piano wire	20 gauge				
F	Peg support	Balsa	$\frac{3}{8}$" × $\frac{1}{8}$"				
G	Tail plane bearer	,,	From $\frac{1}{8}$" square		**Main Plane—**		
H	Tail skid	,,	$\frac{1}{16}$" sheet	**U**	Tip	,,	$\frac{1}{16}$" sheet
J	Fuselage former	Plywood	$\frac{1}{32}$" thick	**V**	Rib	,,	$\frac{1}{16}$" sheet
K	Strut	,,	$\frac{1}{8}$" square	**W**	Centre section spar.	,,	$\frac{1}{16}$" sheet
L	Motor peg	Birch	$\frac{3}{16}$" diam				
M	Nose strut	Balsa	$\frac{1}{4}$" × $\frac{1}{8}$"	**B**	Leading edge	,,	$\frac{1}{8}$" square
N	Thrust pad	Plywood	$\frac{1}{32}$" thick	**Y**	Spars	,,	$\frac{1}{8}$" square
O	Nose block	Balsa	$\frac{7}{8}$" square	**Z**	Trailing edge	,,	$\frac{1}{4}$" × $\frac{1}{16}$"

MODEL AEROPLANE ENTHUSIASTS



Model aeroplane construction and flying form one of the latest hobbies, a pastime constantly growing in popularity. Above is shown a well made plane in miniature and in this section instructions are given for the building of both gliders and aeroplanes.



Photos: Model Aeronautical Press Ltd.

The youthful fans seen above, girls as well as boys, are obviously all air minded and the models they have brought to a meeting of their club tell of their patience and ingenuity as well as sound technical knowledge of aircraft. Modelling is an intensely interesting hobby made more so when the miniature machines fly fast and far with complete air worthiness.

MODEL RAILWAYS

[illegible]

THE THRILL OF OWNING A RAILWAY

This gauge 0 model express is none other than the famous "Royal Scot." On a layout fed by direct current absolute control of the locomotive is possible from any point on the track both in speed and direction. With automatic couplings shunting and marshalling can be carried out with realistic effect.

MODELS have always held a fascination for boys and the variety in existence gives us an enormous choice and field. There are those to be seen at great exhibitions and in museums or shop-windows before which thousands linger, and there are the practical hobbies for enthusiasts, running one's own railway, constructing a model 'plane or sailing a model ship.

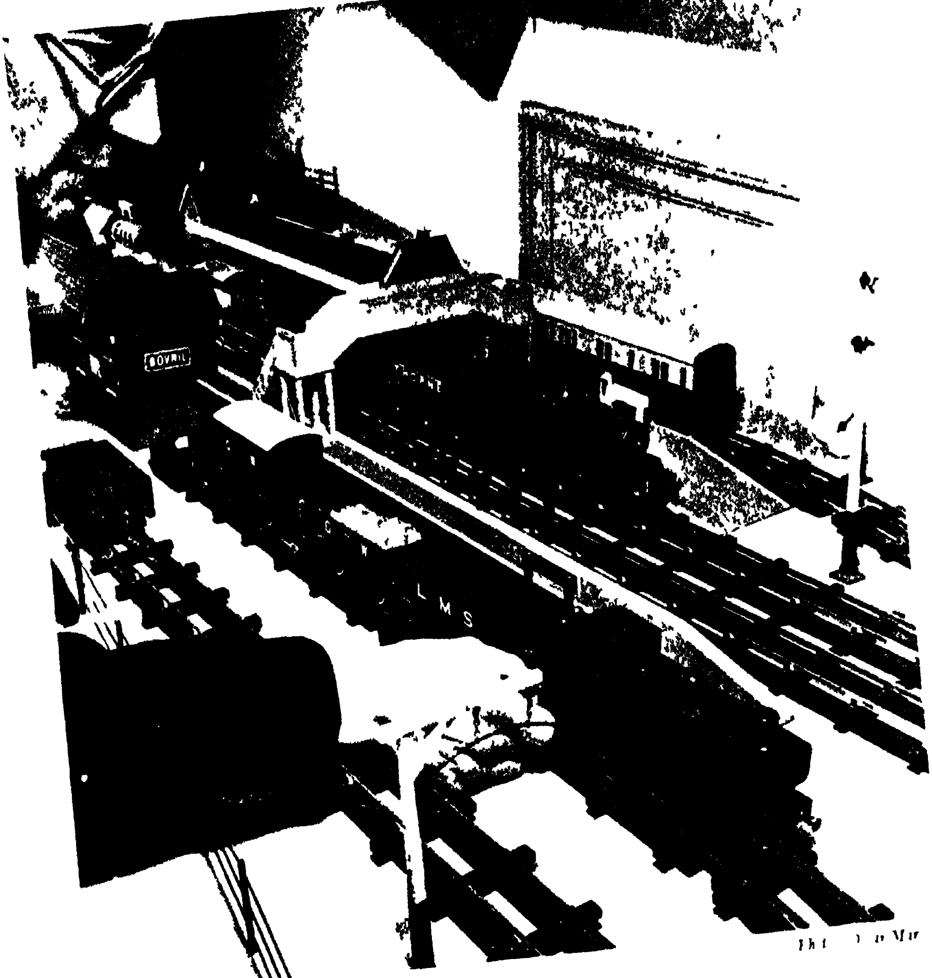
These hobbies are not merely amusements for the young; they belong to that class of hobby in which the interest lasts a lifetime. The young boy of seven and the old boy of seventy meet on common ground when both share the same fascination in models and model making.

About the Gauges

For those of you who favour railways I cannot do better than give a brief review of the different model gauges in use in this country to-day and their special features.

When I first took an interest in model railways, wide gauges were in use, but as in those days model locomotive design bore little relation to the real thing, the size of gauge was not of vital importance. Lately a demand for more realism in models has grown up, which has resulted in the production of smaller gauges. You will see the necessity for this if you study the long type of express locomotive and realise the need for larger radius curves to run a model successfully.

For some years now, gauge "oo" (which is ⅝ inch between the rails) has been making headway. The novelty of a comparatively inexpensive line, of a size which could accommodate a really comprehensive layout on a medium-sized table, meets with great enthusiasm. In the case of the Trix table railway, the locomotives are fitted with A.C. motors, either operated from A.C. mains through a transformer or worked from accumulators. In the Hornby "Dublo" system the engines

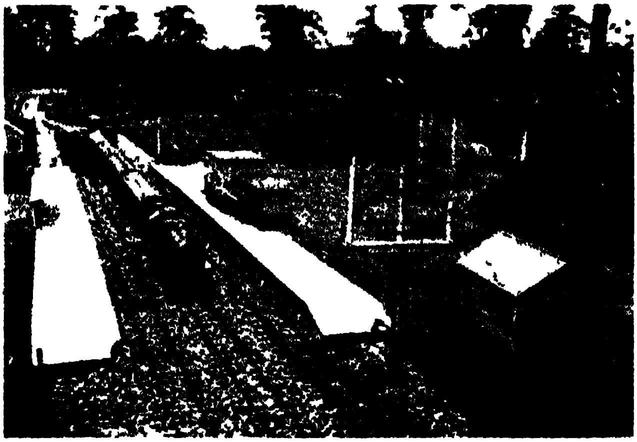


ALL MADE TO SCALE

The making of model railways and trains is a hobby which has a fascination for boys of all ages and the older the boy the more ambitious he becomes. In this photograph is seen the model of a siding near a station. The model maker whose hand is seen on the left is just about to start off the goods train for its run round the track.

are fitted with a permanent magnet motor working off direct current.

"oo" is the gauge for the man who prefers operation rather than construction. In the smallest gauges the building of locomotives and rolling stock is hardly a task for the amateur. He can get his fun from the running of his layout to a timetable schedule, and, if he has an artistic tendency, in preparing railside features and a scenic background for the railway. "oo" gauge is too small for a clockwork mechanism and hardly possible in steam, so electricity is the only prime mover left. The small locomotives are fitted with an alternating current motor, operated from A.C. mains through a transformer. There are other types of electric locomotives, and the model enthusiast will decide which suits him best.

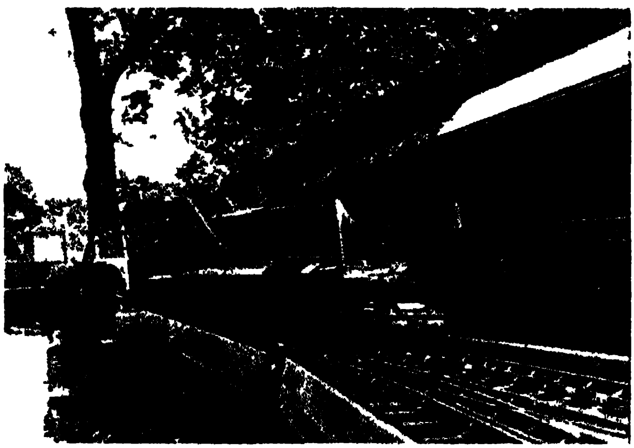


No. 1 GAUGE
Mr Victor B Harrison's 1¾ inch lay out at Bishop's Stortford one of the finest gauge 1 railways ever built The steam loco City of Truro receives the all clear as she passes through Lone Pine Station

Choice of Motive Power

Next on our list is gauge "o" or 1¼ inches between the rails, probably the most popular gauge both in Europe and in America. It is a standard in all countries, and here I think we might discuss the prime movers available to the model railway hobbyist, clockwork, electricity and steam, for gauge "o" is one of the few gauges in which all three are possible and almost equally popular.

Clockwork, I should say, is the most suitable choice for youth One simply winds up a spring and there is no mess or smell or risk to a small child. Also it can be used with equal success indoors or out-of-doors in a gale of wind. The cheapest models are obtainable in clockwork, although most elaborate models can be built with clockwork



A GAUGE "O" LINE
Mr Cecil J Allen sponsors an 'o' gauge clockwork railway out of doors In the garden for speed and healthy exercise or indoors for all the year round working and super detail production

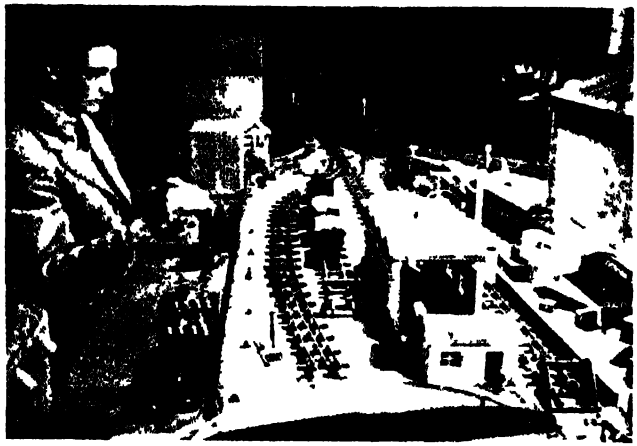
ELECTRICITY FOR GAUGE 1
Another view of Mr Harrison's railway, showing the six arch viaduct in the foreground It is being crossed by a three coach "Southern Electric" set.

mechanisms as prime movers

Steam always seems to make the greatest appeal and is the "senior" prime mover There is with it the realism that corresponds to the work of the actual locomotive, and given common sense, a model steam engine can be both clean and safe in its working

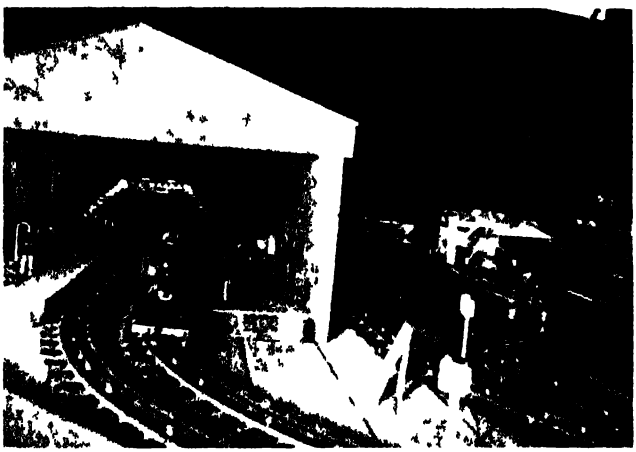
The third power unit is electricity, the most popular prime mover of all Electric trains take different forms firstly models of existing electric trains and secondly replicas of steam locomotives with a specially designed motor concealed in the steam outline body The most universal method is by means of track fitted with a conductor or third rail through which the motor picks up the current

The permanent magnet motor is the type which most model railwaymen consider the best prime mover when it comes to refinement of control These motors



UNDER COVER

An enthusiast at the controls of his gauge o electric railway The line has been built in a garage

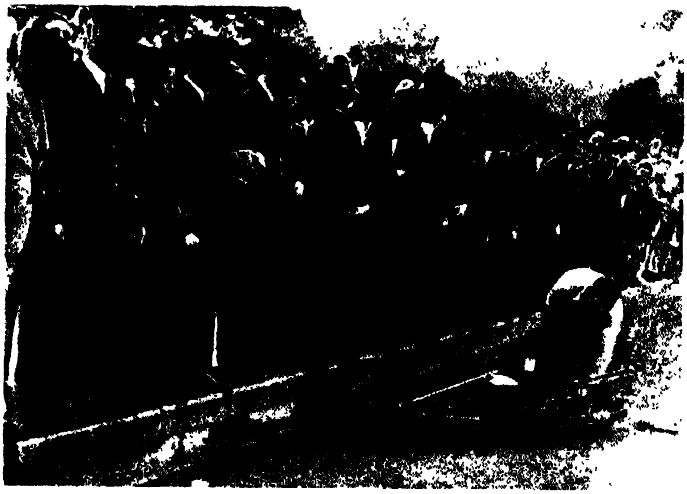


ANOTHER VIEW

This is a different aspect of the model railway above Garages attics basements etc all prove good spots in which to set up a system

AWAITING THE RIGHT-AWAY

Here the train on a model railway is waiting with steam up for the right away This line is gauge 1



TEACHING THE YOUNG IDEA

A group of Sea Cadets is included among those watching this demonstration by the owner of his realistic model steam trawler.

have a current supply of about 8–10 volts D.C., supplied by storage batteries or from the A.C. house mains through a rectifier.

Electric locomotives are also fitted with alternating current motors working off 20 volts A.C. (but in general this is used on the less intricate kind of electric railway), operated from the house mains through a transformer.

Returning to gauge "0," the portable type of track is usually pressed tinned steel plate, but for more permanent structures scale model permanent way is used. To the average hobbyist gauge "0" presents perhaps the greatest scope. He can lay his own track, build his own wagons and coaches, and even construct his own locomotives. Signalling a line also presents another interesting phase of the hobby.

Gauge 1 (or 1¾ inches between the rails) is the next standard gauge, which is particularly popular with those who like an outdoor railway. As the scale grows, clockwork gradually becomes less suitable as a motive power and steam begins to come into its own. Gauge 1 is the commercial "limit" for clockwork traction, but electric power is also used quite frequently, and the size of the gauge 1 steam locomotive is big enough to house an efficient internally fired boiler. This gauge is a proposition for the serious amateur with both time and money to spend.

It is a big jump to the next gauge – 2½ inches – which represents a scale of ½ inch to the foot. This is the size beloved of amateurs with engineering knowledge, who build their own working steam models, either fed by methylated spirit or with proper fire-box using solid fuel.

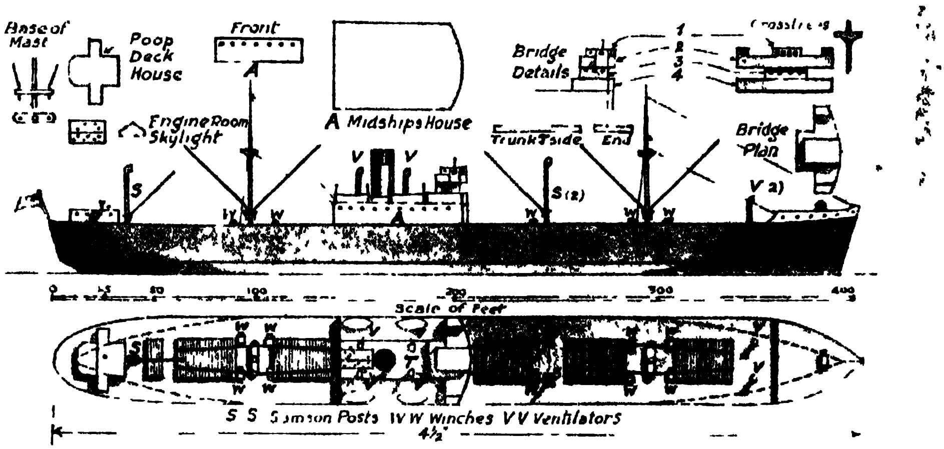
Ships of All Kinds

Whether you own one, build one or make a study of shipping, this hobby makes a strong appeal, for being a seafaring nation, the ocean and the ships which sail the Seven Seas are uppermost in a British boy's mind.

Model boats can be inexpensive ones made from pressed tinplate and driven by a clockwork motor, or with carved wooden hulls powered by either an electric motor or steam engine. This more elaborate type can be built in varied forms such as steam-yachts, tramp steamers, cargo boats, lifeboats—even modern liners or warships.

The most popular means of propulsion among amateurs is electricity, because there is less danger of the boat getting becalmed through the boiler running dry when it is in the middle of the lake. Where high speed is required, however, steam or petrol engine propulsion is far and away the most satisfactory.

MODEL SHIPS YOU CAN MAKE



Drawing specially prepared for this

FIG. 1 How to build the model cargo steamer

MODELS of ships are most fascinating, and it is possible to have a whole fleet merely for the trouble of making them In the windows of many of the principal shipping companies are large and perfect models of vessels owned by those companies These are costly, constructed by skilled workmen with tools specially made for the purpose, and they are accurate down to the smallest detail

Tests Made by Model

At exhibitions you can often see model ships at their very best. Many of them are made on a scale ¼-inch to the foot, or $\frac{1}{48}$th real size, and it is wonderful how effective the skilful work of model makers appears, especially when tall-masted sailing ships are constructed

Actually, models play an important part in shipbuilding and before a mighty vessel is ordered from the shipwrights a scale model is made and tried out in a huge tank. The tests show better than anything else could do the results likely to be obtained from the finished craft.

Some small-scale ships are quite 6 feet long, but, with materials which everyone has at hand, models 6 inches long and less can be made, not quite so detailed but giving a very satisfactory representation of the full-sized craft.

The materials required are: small pieces of straight-grained wood, glue, pins, paint, fine wire, a sharp knife, some glasspaper and plenty of patience. Select the ship you wish to model. Suppose that it is the cargo steamer illustrated in our coloured plate. This is a common type of modern merchant ship which sails the Seven Seas carrying all kinds of goods wherever they may be found, perhaps 400 feet in length with a beam or width of 54 feet and a tonnage of 9,000 deadweight. We, however, are only concerned with what can be seen of the ship, so that anything below the waterline does not matter. As for the drawings, they are to scale and the scale of feet is shown immediately underneath the profile, giving measurements down to 10 feet.

Making a Start

Select a piece of wood of suitable length and breadth and see that it is perfectly flat, with the edges straight With tracing paper and a sharp pencil trace the outlines of the profile from the outline in Fig 1 and also that of the plan, and transfer these to the sides and top of the piece of wood with the aid of carbon paper, using a hard, finely pointed pencil for the purpose Now cut the wood to conform to the shapes you have traced and remove any roughness with a small piece of glass-paper If you have a fret saw this will save a lot of trouble, but it is not necessary

Trace also the shapes of the deck fittings on thin wood, such as the deck houses, boats and funnel Using a small finely pointed brush, paint the hull with oil colour, thinned with turpentine or water colour The illustration shows the colours to be used The deck houses ought also to be painted and both the hull and deck houses allowed to dry before the fittings are glued to the hull A better finish will be attained if two very thin coats of paint are given instead of one thick one The masts are long pins, such as those used for Flag Days, fixed points upwards, having cut off the heads, and these should be put in the positions indicated before the other fittings A small pin vice holding a very fine drill is useful for boring holes in models of this scale

The shorter Sampson posts should also be made of pins or wire cut to the

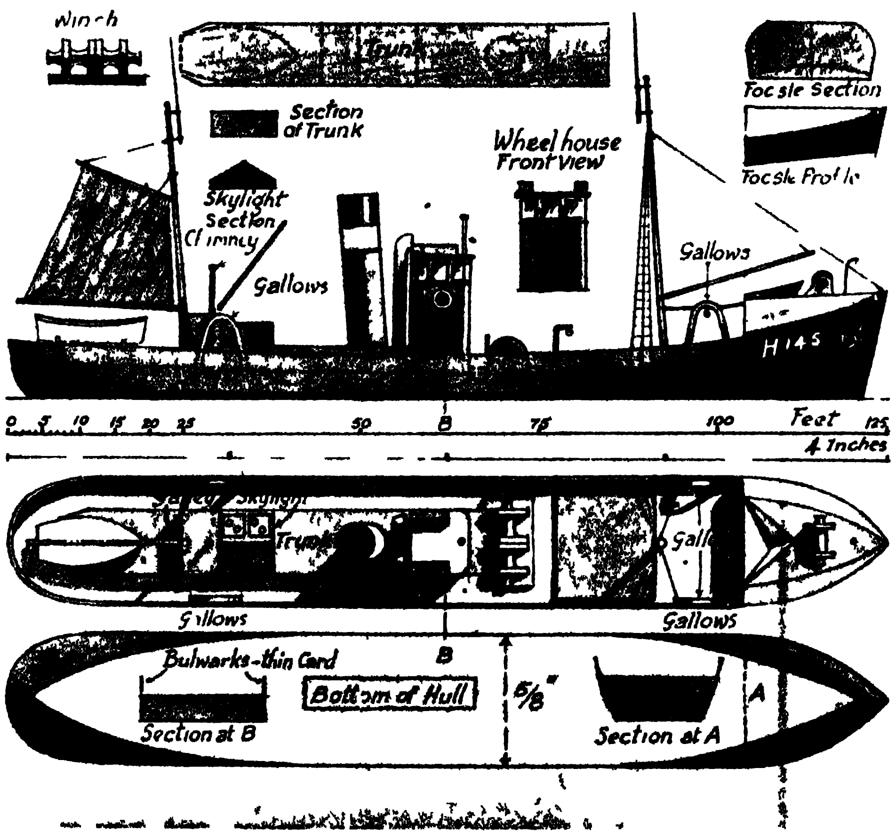


Fig 2 —How to make a model steam trawler

required length. The derricks, constructed of fine wire, should be put in position last of all. Use any good liquid glue sold in tubes, though a waterproof glue is best, as it is impervious to damp. Be sparing with glue and use a sharply pointed match-stick with which to spread it. If you have tweezers you will find them very useful for placing the fittings in position. When using fingers only, glue gets on to very small fittings, and they become most difficult to handle. Build up the charthouse and bridge in the order indicated in Fig. 1; and, unless your eyes are very good, a small pocket magnifying glass will be helpful in getting everything correctly placed. The hatches (painted black) may be cut from veneer or merely painted on the deck.

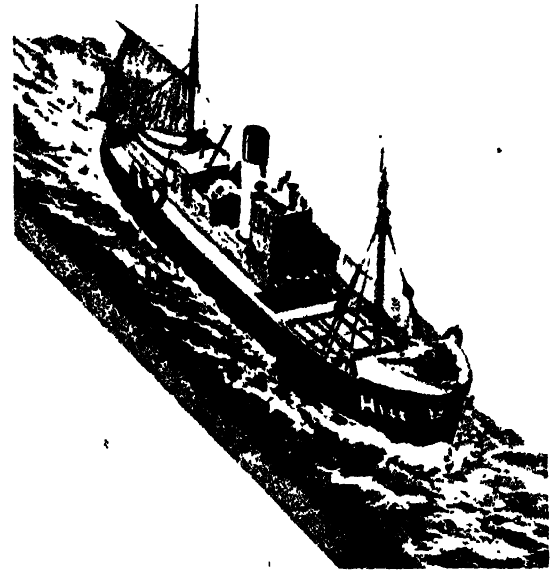


FIG. 3 A photograph of the model of the trawler made by the author The ship is four inches long and is mounted on a base seven inches long The sea is Plasticene painted.

Mounting the Model

Now, if you have paid careful attention to scale, the model is complete, but if you like to go further and make the ship into a picture model Fig. 3 is an example. Mount the model on a piece of plywood about twice the length of the ship—9 inches long and 3 inches wide—or larger than this if you like. Cut from plywood a piece for the back, and two pieces, one for each end and a piece the same size as the base for the top. Using green or grey Plasticene, model the sea very thinly round the ship, painting it with thin oil colour in green and blue, and white for the bow wave and crests; then cut a piece of stout paper, and, before putting it into position, paint an appropriate sky in water colour and a distant coastline. A tiny piece of cotton wool pulled out and rubbed in soot may be glued into the funnel.

Fix the sides and back with panel pins, glue to the base and then place the background in position, bending the two ends round so that they leave no corners. The underside of the top should be painted blue like the sky, before it is fixed in position, and one must remember that it may be seen from a low view-point. Finally, a piece of glass cut exactly to the size of the case will give a good finish to the model and, of course, keep out dust. This can be fixed with passe-partout.

The second ship illustrated, Fig. 2, is a steam trawler, not much more than a quarter the length of the tramp steamer; and, because on a larger scale, less difficult to model. Vessels such as these bring us fish from within the Arctic circle; and, although so small, they weather the most violent gales and stay away for long periods from their home ports. This ship is 125 feet long, has a beam of 23 feet and a gross tonnage of 270. In this case the ship has a sheer, *i.e.*, the deck is not level from end to end, and to give

the craft her true appearance this should be shown.

The best way to bring this about is to ignore the forecastle (see details), treating it as a separate piece, and shape the deck itself first, so that the forecastle can be fixed afterwards. At this scale it is possible to put a lot of detail into the model. For example, the bulwarks can be cut from thin strips of Bristol board and glued in position. The rigging also might be attempted. In the Napoleonic wars many elaborately rigged ships were modelled by prisoners of war and in some of the very small models human hair was used for the rigging.

Modelling Sailing Ships

A case for this model (Fig. 4) might well be larger than that for the tramp steamer and should represent a fishing ground, the model in the foreground, with other trawlers fishing in the distance. A rope from each of the gallows would show the trawl down. Fig. 2 shows plan and profile, and details of the trawler, all of which can be traced so that the model will be to scale—scale being of vital importance if a satisfying effect is to result. These two ships are comparatively easy, but more difficult and complicated ones can be attempted when some practice has been obtained.

Working drawings of many well-known ships are available, and it is a simple matter to reduce these to the scale required, whilst the more elaborate might be worked to a slightly larger scale. An excellent test of the quality of work is to take a photograph of your model and compare it with a photograph of the real ship. Sailing vessels are, of course, the most difficult because of the wealth of spars and rigging. Close study of originals is essential, but the subjects for water-lin models are endless.

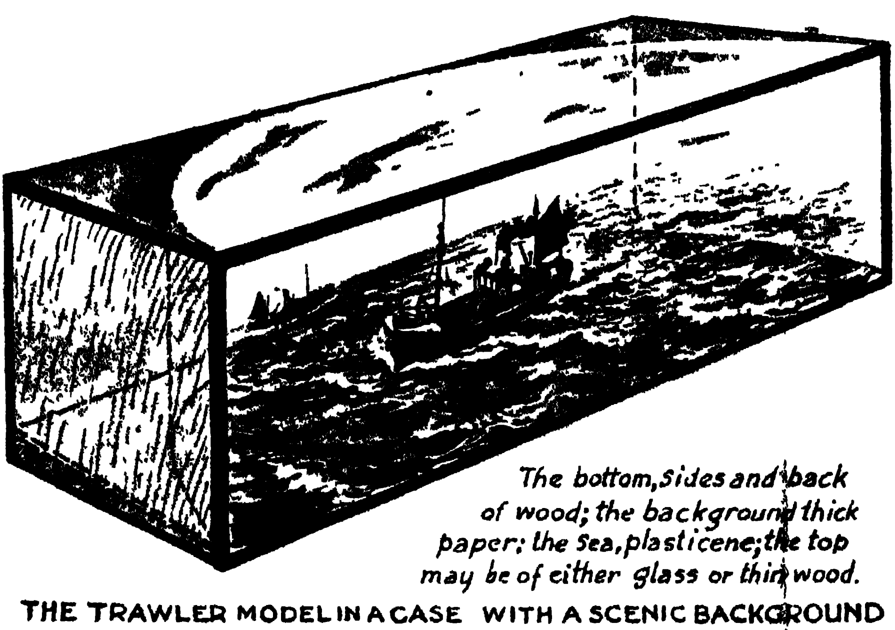
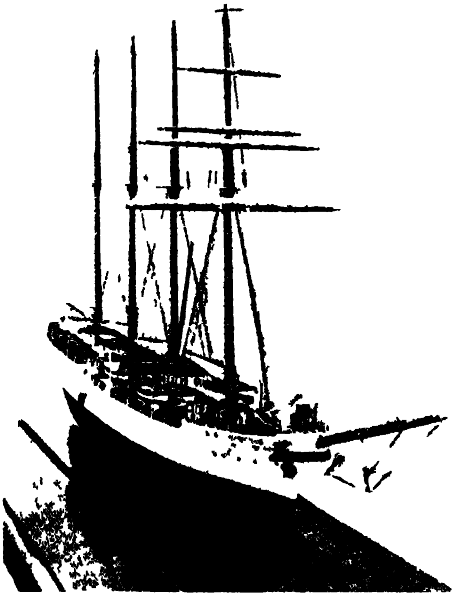
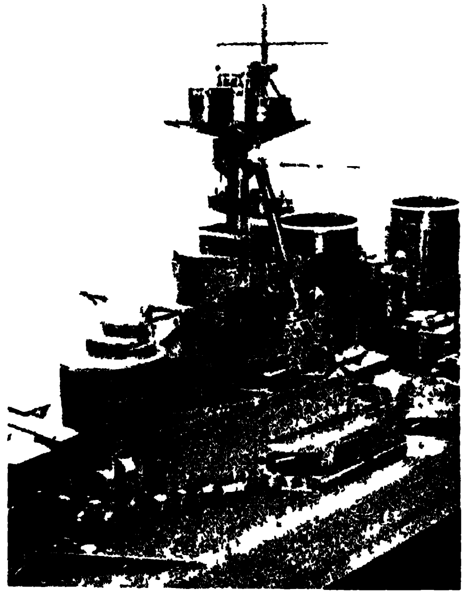


FIG. 4.—A case for the model trawler.

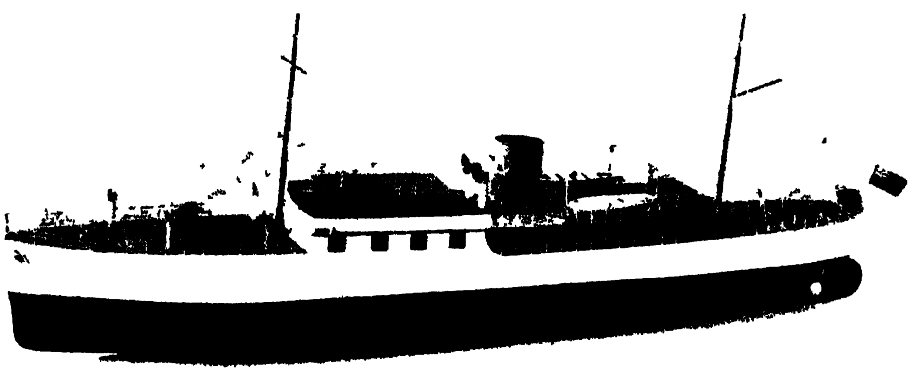
A PAGE OF MODEL SHIPS



This is a beautiful scale model of a Training Ship, the *Juan Sebastian de Elcano* It is one fiftieth actual size

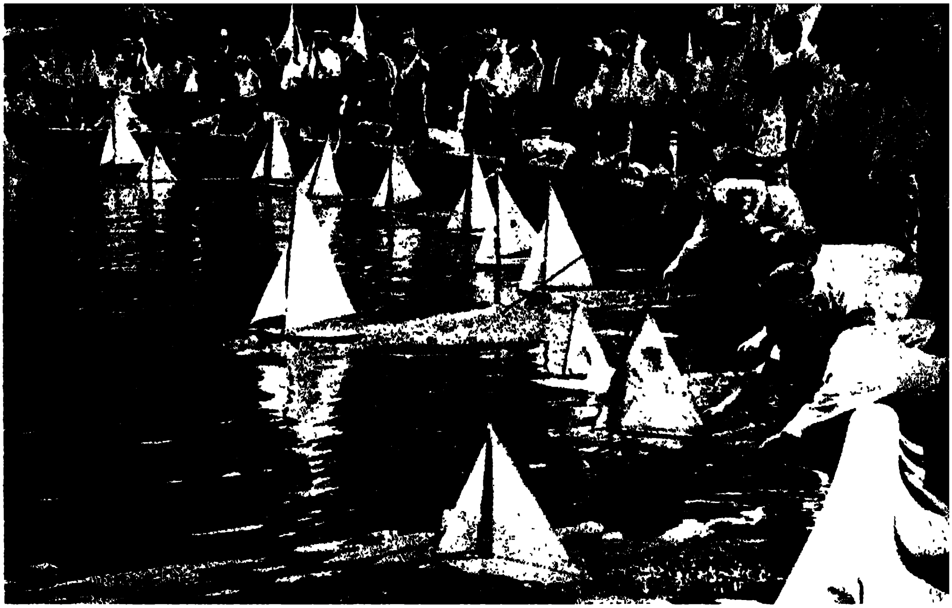


Here is a model of a famous British battle ship one sixty fourth actual size Vessels of the Royal Navy make splendid models



Here is a working model of a private steam yacht, and it can be seen how perfect the vessel is down to the smallest detail The construction of ship models is a clever combination of science and art forming one of the most fascinating of pastimes

BOATS AND BOAT BUILDING



MODEL BOATS ON A LONDON POND

Sailing model yachts is a splendid hobby. Safe as well as interesting, the handling of one of these small craft calls for a good deal of skill. In gaining the knowledge necessary to get the best out of a boat, its skipper will soon acquire a sound working knowledge of the principles governing wind and sail.

BUILDING model boats is one of the most fascinating hobbies that any boy can take up. No great skill is required beyond the ability to handle tools moderately well; whereas the pleasure and sport derived from the completed models will well repay all the care and trouble expended.

A Model Sailing Boat

Here is an easily-made boat which will sail well if care is taken in building it (see Fig. 1).

The hull is made from a piece of wood 9 inches long, 2½ inches wide, and 1 inch thick. Mark a centre line along the top and bottom of the wood and then carefully outline the shape of the hull as shown at B (Fig. 2). With a tenon saw, roughly cut away the parts C, C, and also the corners at the back. Now proceed to carve the hull to shape with a chisel. You will see, by looking at diagrams A and D, what the front and side of the hull should look like when finished. Give the hull a good rubbing all over with glasspaper. To represent planking, the parallel lines along the deck can be scored on with a bradawl, using a ruler as a guide.

For the keel, take a piece of ⅜-inch wood 5¼ inches long and 2 inches wide and saw it to the size given at E. Taper the front part at F so that it forms a narrow edge. On each side of the bottom of the keel, nail a strip of sheet lead about ½ inch wide and file this to a round shape. To fix the keel in place, cut a slot ⅜ inch wide along the centre of the bottom of the hull, and after gluing the keel in place, drive in a couple of long fine nails as shown in diagram D.

The Masts, Spars and Sails

Wooden knitting needles, about $\frac{3}{16}$ inch diameter, can be used for the mast and spars, the lengths of which

are given in the sketch of the finished boat. The bowsprit is fixed to the deck by two wire staples, and the bottom of the mast is pushed into a hole about $\frac{3}{8}$ inch deep in the hull.

The sails can be cut out of fine white linen to the sizes given, allowing about $\frac{1}{4}$ inch extra all round for hemming. Use very thin twine for the rigging and attach the ends of the shrouds to small screw eyes fixed in the deck.

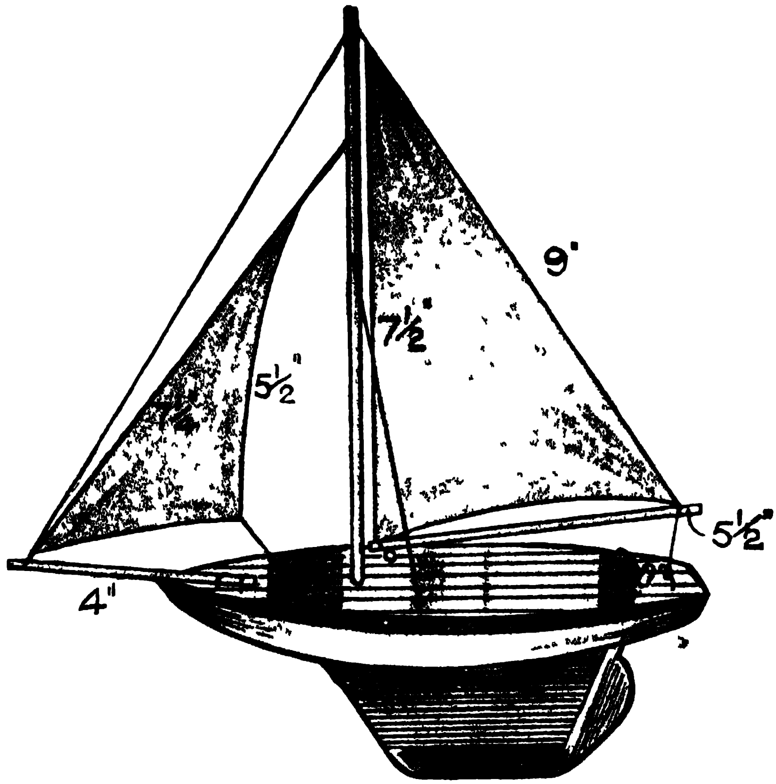


FIG. 1
The model yacht as it appears when the construction is completed

The Rudder

To complete the boat, a rudder can be fitted, fashioned out of a piece of $\frac{1}{16}$-inch fretwood to the dimensions given at G, the top part working in a hole in the hull, while the bottom part is held by two wire staples.

Give the hull two coats of white enamel and paint a $\frac{1}{4}$-inch band of bright red or blue all round the hull. When quite dry, your smart little craft will be ready for its trial trip.

A Model Racing Yacht

The model yacht illustrated in Fig 3 is of very simple design, only two pieces of wood being used in the construction of the hull, details

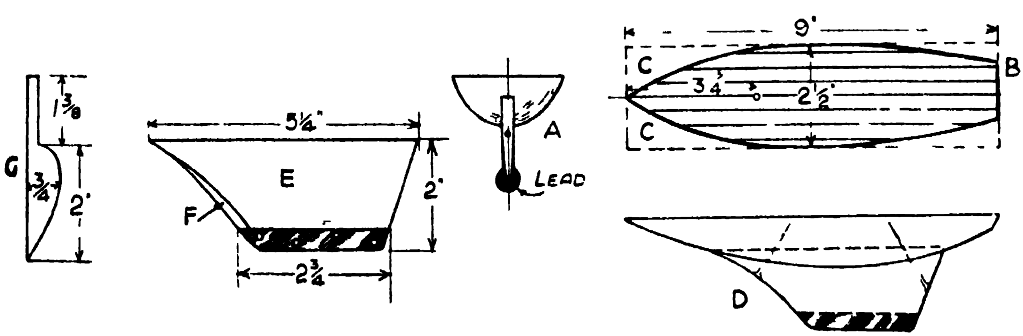


FIG. 2
Diagrams A and D show the front and side views of the hull Diagram B illustrates the shaping of the hull, while Diagrams E F and G show the keel and rudder

of which are shown in Fig. 4. Begin by cutting a cardboard template to the measurements given in Fig. 5. Then select a piece of straight-grained wood 15 inches by 5 inches, and at least ¾ inch thick. Thicker wood may be used, but will mean more trouble in cutting and shaping. Draw a centre line longitudinally upon this piece of wood. Place the straight side of the template against it and run a pencil round the curve; then turn the template over and draw the other curve, thus ensuring balance. Cut round the outline with a fretsaw, and the hull is ready for shaping.

The best tool for this purpose is a small metal plane. Work lengthwise, first rounding the edges, and continuing until the hull is shaped like the cross section in Fig. 4, but leaving flat a portion along the centre for the attachment of the keel-fin. Shape the bows and the stern with a sharp penknife, and finish off the hull with sandpaper. The keel-fin is cut from ⅜-inch wood to the measurements given in Fig. 4, the front and back edges being rounded as indicated by the shading. It is secured to the hull by three 1½-inch brass screws, the heads of which are sunk flush with the deck. Cast a lead keel slightly larger than required and screw it to the bottom edge of the keel-fin, afterwards trimming it down with a file. The rudder and rudder-post are cut in one piece of ¼-inch wood, the post being rounded and a hole bored through the hull to receive it. The lower end is pivoted upon a right-angled brass wire staple as shown by the dotted line (see Fig 4).

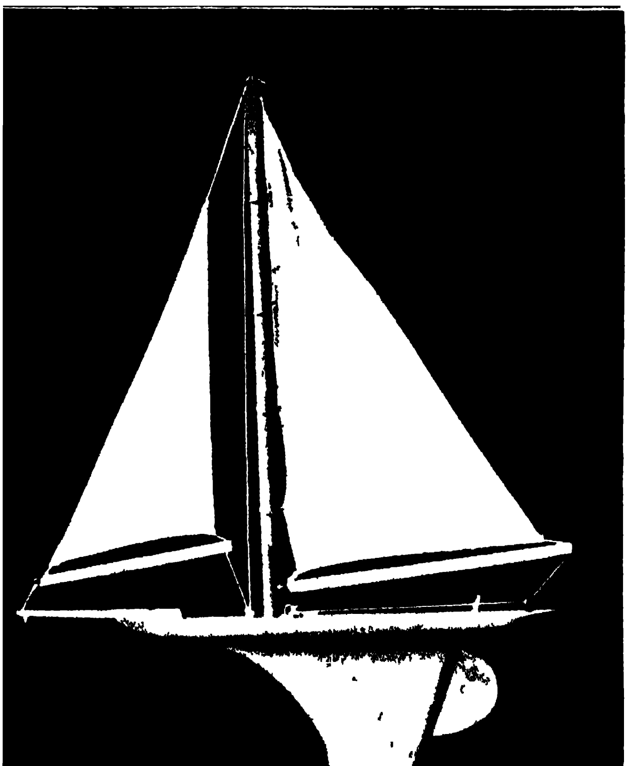


FIG. 3

Here is an actual photograph of a workmanlike model yacht Cheap and simple to make, this model will give excellent results

The Mast and Sails

The mast is 16 inches high from the deck level but is cut ½ inch longer to allow for stepping. Cut it ⅜ inch square, then plane and sandpaper it until perfectly round and smooth. It fits tightly into a hole made at a point on the centre line 5 inches from the bows. The bowsprit is 5 inches long and is secured by two small nails. The mainsail boom is 9 inches long and is attached to the mast by means of a small brass screw-eye and a brass wire staple as shown in Fig. 4; the other end being rounded and a saw-cut made in it for securing the sail. The jib-boom is 6 inches long and is similar in construction to the main-boom.

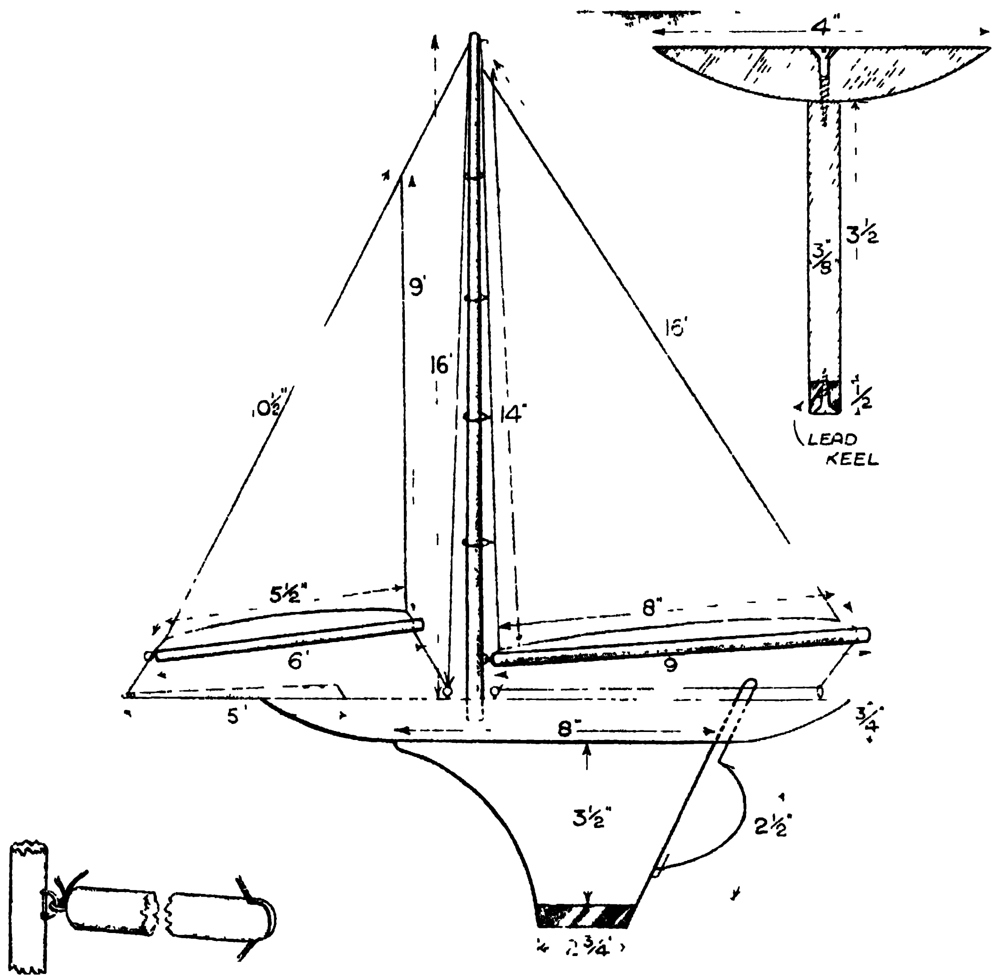


FIG. 4

These diagrams show the constructional details of a model racing yacht. In the centre is the side elevation of the boat, whilst top right is a cross section of the hull. At the bottom left hand corner you are shown how to attach the mainsail boom.

The sails may be made from any convenient white material, or the special fabric sold for the purpose may be used. Cut a paper pattern before cutting the material, and allow an extra ½ inch all round for hemming. If you mistrust your powers with the needle, get a female member of the household to do this part of the job for you. Four rings made from brass wire are sewn at equidistant points along one edge of the mainsail, and a length of thin cord is fastened to each of the corners of the sails for attaching them to the spars. The top of the mast has a saw-cut made in it where the cord passes over it, and three brass screw-eyes screwed to the deck at the positions shown complete the yacht.

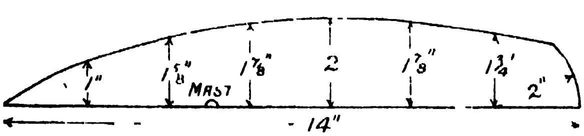


FIG. 5
Cardboard template for the hull

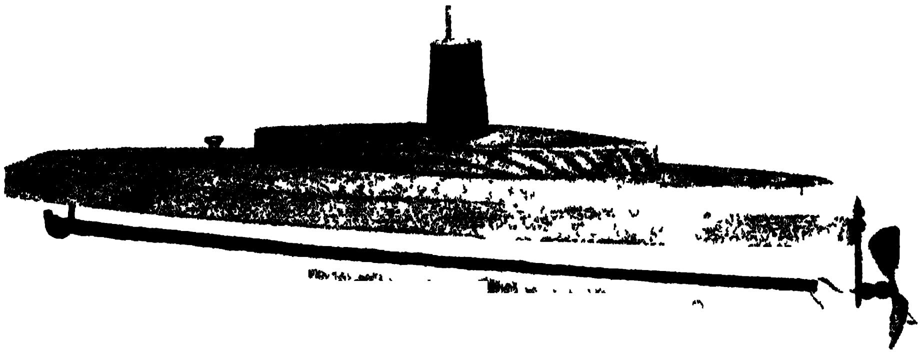


FIG. 6 ELASTIC-DRIVEN MODEL SUBMARINE

In this photograph you are shown a small submarine that is simple and inexpensive to make. The motive power is derived from the elastic seen under the hull

A Model Submarine

A trim little submarine can easily be made in an hour or two from a few odds and ends. The hull and raised deck are of wood, and a cork forms the conning tower, which is surmounted by a periscope, fashioned from part of an aluminium curtain pin or a piece of tinned-iron wire.

The Hull

For the hull take a piece of wood 10 inches long by 1¾ inches wide, and ⅝ inch thick, and after planing it on both sides, mark a centre line on one side. With a pencil carefully set out the shape of the hull (A) (Fig. 7), saw away the parts not required and finish the sides smooth with a chisel. Now chamfer or bevel the top edge of the hull all round, as shown in the remainder of the sketches. This can be done with a small iron plane and a chisel.

The Deck

Cut the raised deck (B) from a piece of wood ⅜ inch thick and in the middle of this screw on a cork, which serves for the conning tower. Fix the raised deck to the hull with two ¾-inch nails. The lower end of the periscope is pointed, and is simply pushed in a hole made in the cork with a bradawl. For the bollard, seen just in front of the raised deck, cut off the top part of a French nail, file the end to a point and hammer it into the hull so that the head stands up about ¼ inch.

A piece of thin strip brass can be filed to shape to form the bearing bracket (C), small holes being drilled as indicated. Two small brass screws fix this bracket to the stern of the boat.

The Propeller

To make the propeller, obtain a flat piece of tinplate, and on it mark a circle 1⅜ inches diameter, and then set out the shape of the propeller blades. With a pair of old scissors cut away the metal not required. File the edges of the blades smooth with a file, and drill a tiny hole through the centre of the propeller to take the shaft. This consists of a 1½-inch length of plated wire taken from a thick bent-wire paper fastener. Lightly solder the propeller on to the end of the shaft, and then

twist the blades so that the outer edge of each one makes an angle of about 45 degrees with the shaft when the propeller is viewed edgewise. Slip a couple of glass beads on the shaft, and with a pair of pliers bend the end to form a hook to take one end of the rubber " motor."

Making the Hooks, etc.

The front hook (D) is made from a blanket pin and is driven into a hole made in the hull. The rubber " motor " consists of 18 inches of $\frac{1}{16}$-inch square rubber strip, the two ends being bound together with strong thread. After placing the strands on the hooks, rub them over with a little lubricant as explained below. All the woodwork of the little craft can be given a coat of grey paint to finish it off.

On winding up the " motor " by means of the propeller, and placing the boat on the water, it will glide along quite realistically until the rubber strands become unwound The boat rides nicely on the water and does not require a keel of any kind.

By an adaptation of the simple ideas contained in this section, you will be able to make quite a lot of little working models, for twisted elastic is a simple and inexpensive means of driving them.

By the way, for best results you should lubricate the elastic with soft soap, to enable the strands to slide over one another easily, and also to prevent the edges of the strands cutting into one another Soft soap enables more turns to be given to the elastic skein

Small tubes of elastic lubricant may be purchased for a few pence from most manufacturers of model aeroplanes. If you decide to use soft soap, use the pure green sort, obtainable from any chemist Do not use vaseline, or oil, or you will speedily ruin the rubber.

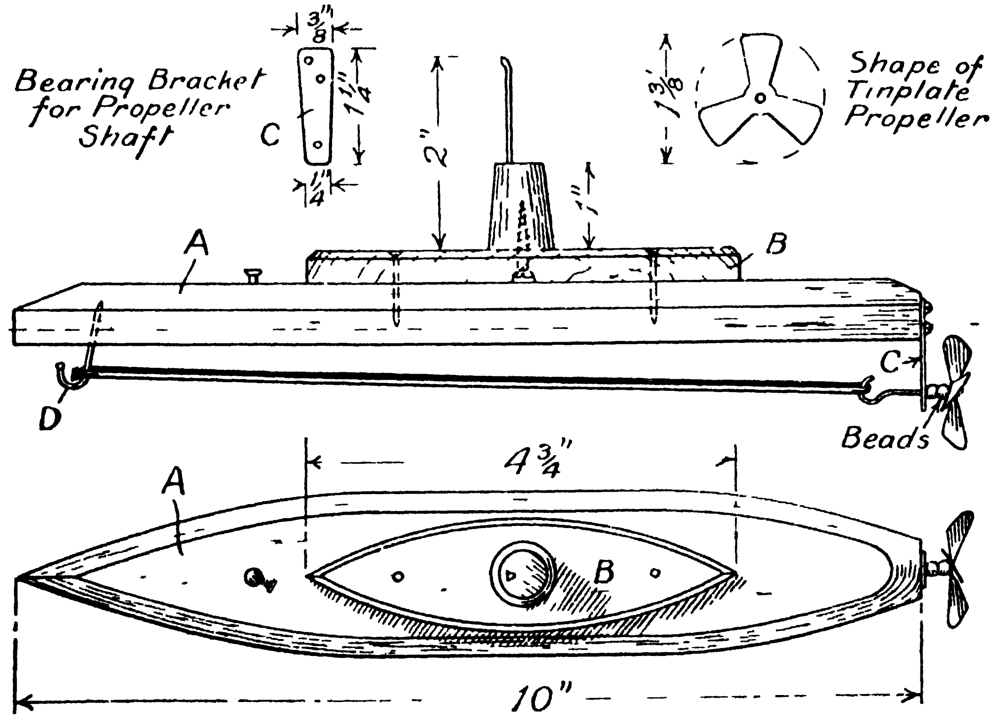


FIG. 7.—CONSTRUCTURAL DIAGRAMS FOR SUBMARINE

Of the two main diagrams the upper one shows the side elevation and the lower the plan of the submarine The two smaller sketches show the propeller bearing bracket which is fitted to the hull at C and the method of cutting out the propeller itself

KITES AND HOW TO MAKE THEM

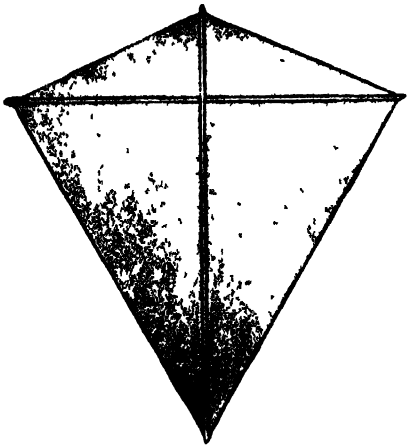


FIG. 1

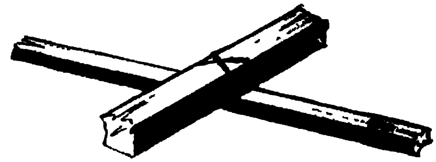


FIG. 2

These two illustrations show the first steps in making the kite described here. Fig 1 represents the frame of the kite, whilst in Fig 2 you can see just how the bow is glued and lashed to the backbone.

HERE is a design for a kite that is very easy to fly, if carefully made and balanced. For the backbone cut a strip of straight-grained spruce, deal, or any light wood. This strip should be planed down to ¼ inch section, and cut 30 inches long. A strip of cane is needed for the bow; this should be slightly less in section.

The bow must be glued and lashed with strong thread to the backbone at a distance of 6 inches from the upper end; and, when the glue has set hard, cut to a length of 30 inches. To preserve the balance, measure 15 inches each way from the centre.

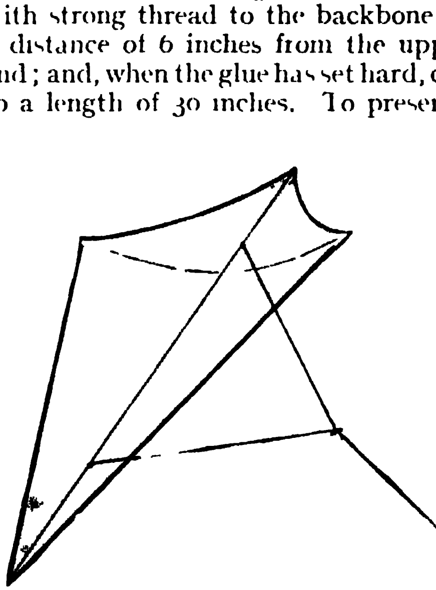


FIG. 3
The kite when completed

A length of strong thread, or fine twine, is tied at its centre to the tip of the backbone and tied right and left to the tips of the bow; see that both are the same length so as to keep the bow at right angles to the backbone.

The frame will now present the appearance shown at Fig. 1. For the covering use strong, brightly-coloured tissue paper, in one piece if possible. Lay the paper flat on the table, smear the face of backbone and bow with paste or liquid glue, press down on the paper, then turn the whole over and rub the paper well into contact. When set, trim the paper, with about ½ inch of margin, to the shape of the frame, paste the edges and turn over the thread, then press well down.

Strengthen the four corners by pasting over a small triangular piece of paper. For the bridle, cut a length of twine about 4 feet and attach it to the backbone about 4 inches from the top and 6 inches from the bottom.

Cut a tiny notch in each end of the bow about ¼ inch from the tips. Into the notch, at one end, tie a length of twine, then slip the twine round the other notch, and draw the ends of bow

together until the depth of curvature is a trifle over 3 inches.

The kite line is attached to the bridle, so that the upper portion of the bridle is shorter than the lower. When flying the kite, vary the position of the line to get the best results.

How to make a fine Box Kite

To make a box kite you will require, first of all, four straight strips of light wood, each 2 feet 2 inches long and ½ inch square, and two pieces of thin coloured paper measuring 4 feet 2 inches long and 10 inches wide. Take the strips of coloured paper, turn over the edges 1 inch and glue down the folds after inserting a length of fine, strong string in each fold. When completed, glue the ends of each paper strip with a 2-inch overlap so as to form continuous bands 8 inches wide. Now fold each band to divide it into four equal parts, and at each crease glue one of the long sticks. The outer edge of each band should be 1 inch from the ends of the sticks, and there should be a space of 10 inches between the bands, as indicated in the first diagram. Before gluing the sticks in place, slightly notch each one at a distance of 5 inches from each end to receive the notched ends of the cross-pieces A (Fig. 4).

For the cross-pieces, take two pieces of $\frac{3}{16}$-inch by $\frac{5}{16}$-inch stripwood, each 16½ inches long, place them together and drive a fine wire nail through the centre, turning the end of the nail up underneath. Treat two more pieces of the same length in the same way. Notch the ends as at B, open out the cross-pieces, and fit them inside the kite. They must not fit too tightly, or they will split the paper. If they are too long, shorten them slightly and deepen the notches.

The flying line is tied on to one of the long strips in the position indicated at C. To fly the kite, let out about 20 yards of line, and get someone to throw up the kite a short distance in the usual fashion.

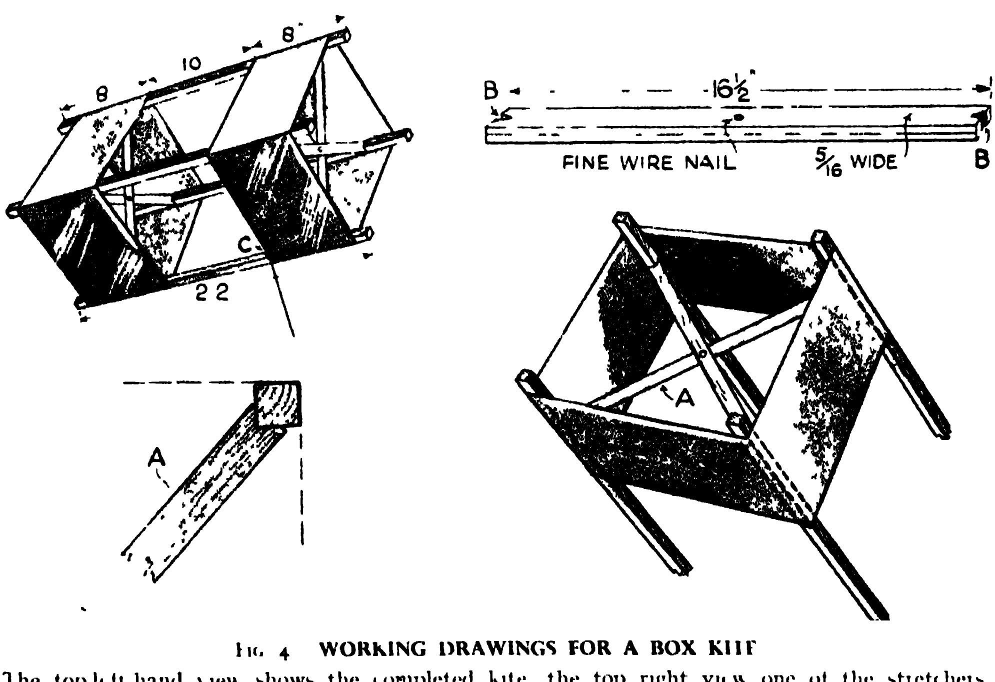
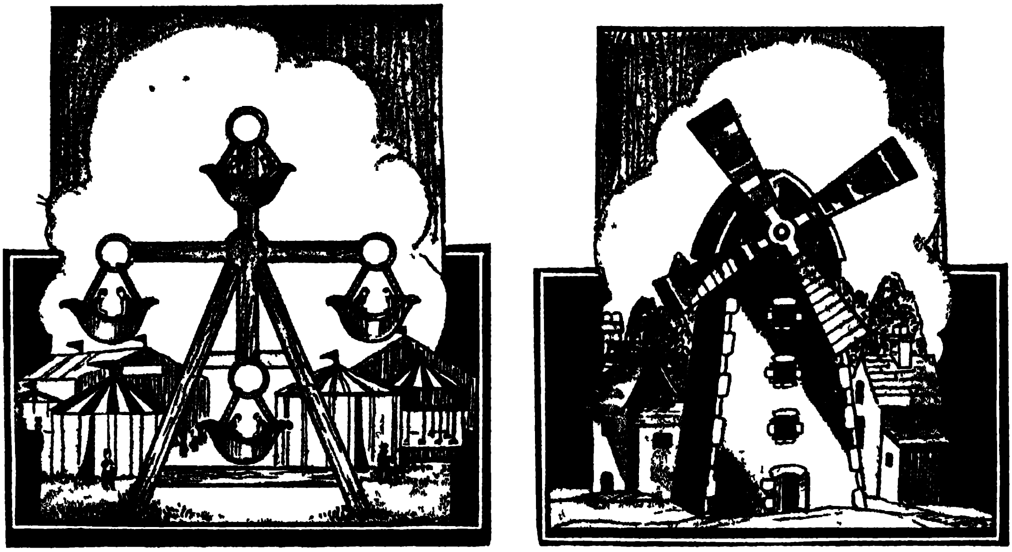


FIG. 4 WORKING DRAWINGS FOR A BOX KITE

The top left hand view shows the completed kite the top right view one of the stretchers, the bottom left how the stretchers lock diagonally against the main members and the bottom right one of the cellules with the stretchers A in position

WORKING SAND MODELS



A DOUBLE-SIDED MODEL

Here is a fascinating sand model which on one side represents a windmill and on the other a set of big-wheel swing boats

HAVE you ever tried making motive models, using sand as the working power? The steady trickle of the golden grains through a hopper on to a suitable mechanism can be turned into motive power in a similar way to the turning of a water wheel by a running stream. The above illustration shows the sort of thing which can be built, and it has been so planned that the sand works two different models from the same mechanism. The picture shown illustrates actually the back and front of the same article, and it can be seen there that on one side a model windmill with movable sails is incorporated, while on the other is one of those big-wheel swinging-boat arrangements seen at any fair.

How It Works

The complete model shown is $7\frac{5}{8}$ inches high and $5\frac{9}{16}$ inches wide, with a box-pattern centre 2 inches deep. The mill sails of the model are turned by a rotating mechanism inside, and the illustration at Fig. 1 shows quite plainly how this is done. A box is made up, through the top of which sand is poured into a hopper which releases it in a steady stream on to a series of buckets. The weight of the sand turns these buckets on a central spindle, and the sand is emptied into a drawer container beneath. So long as the sand runs from the hopper at the top into the buckets to weigh them down, so the rotating spindle will turn the sails and the swinging-boat arms on the outside of the model.

Draw and Paint the Pictures on the Wood

The various parts required are clearly shown in Figs. 3 and 4, and instructions on the manner of their cutting are also printed. In the top right-hand corner of Fig. 3 is an outline of one of the sides, and marked thereon are various dotted lines clearly indicating the position of the joining parts. The back and front are to be cut out of $\frac{3}{16}$-inch wood, and the positions of the parts are marked on it. For instance, the angle of the hopper made by the two parts A and B is obtained by marking the position on the inner surface of the sides, whilst a similar angle should be

marked off for the sand chute at the bottom. The pictures of the mill and swinging-boats should, of course, be drawn on these two parts, but the back and edges must be cleaned up in the ordinary way. Put the two parts together in boring the central hole to ensure that the spindle is horizontal.

The Box Container

The container is made up of the back and front, two sides, and a top and bottom. The two sides go between the back and front. They are shorter than the length of the model itself, but are glued between the back and front flush with the top. This will provide a space of about $1\frac{5}{8}$ inches below, which is taken up later on by the drawer holding the sand. The top and bottom of the model are plain rectangles of wood glued above the sides and fronts. Although these parts have all been cut out and tested in place, only actually glue one front, the top and bottom and the two sides. This will leave the back of the model off, so that we can place in position the actual mechanism.

First get the pieces A and B, which form the sand hopper, and glue them at the angle indicated in the working drawing. One end of each has to be chamfered to the section shown to make it lie flat to the top. The piece A has a semicircular hole for the sand to trickle through, and in order to guide it up to this hole, little angle blocks cut from any odd piece of thick wood are glued into the corners, as shown by the detail at Fig. 2.

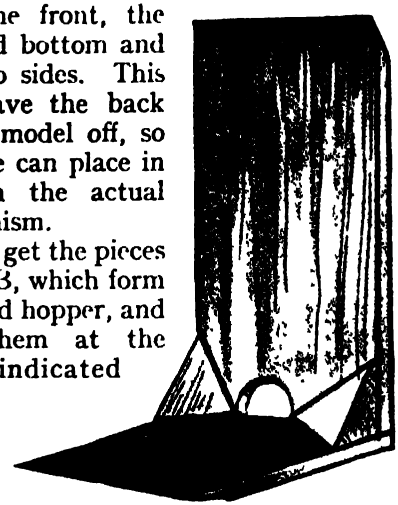


FIG. 2
Hole and wooden blocks to guide sand.

Making up the Wheel

Now make up the wheel itself, using $\frac{1}{16}$-inch pieces throughout. Two shaped sides are fitted over the pieces which form the scoops or buckets for the sand. The completed wheel is shown in Fig. 3, but one side has been purposely omitted to make the actual construction clearer. Be careful to see that the wheel blades A are glued at right angles to the sides, and to each other, so that a perfect square is formed round the central axle opening. To make a better scoop, the small pieces (B) which form the front of the box are glued to the blades themselves and on to the sides of the wheel. The axle which passes through the centre of the wheel should fit it quite tightly, and a liberal supply of glue added round the outside of it will give further strength.

Below this wheel are fitted the pieces

FIG. 1
Mechanism showing how the sand wheel works.

PATTERNS OF THE PARTS USED-

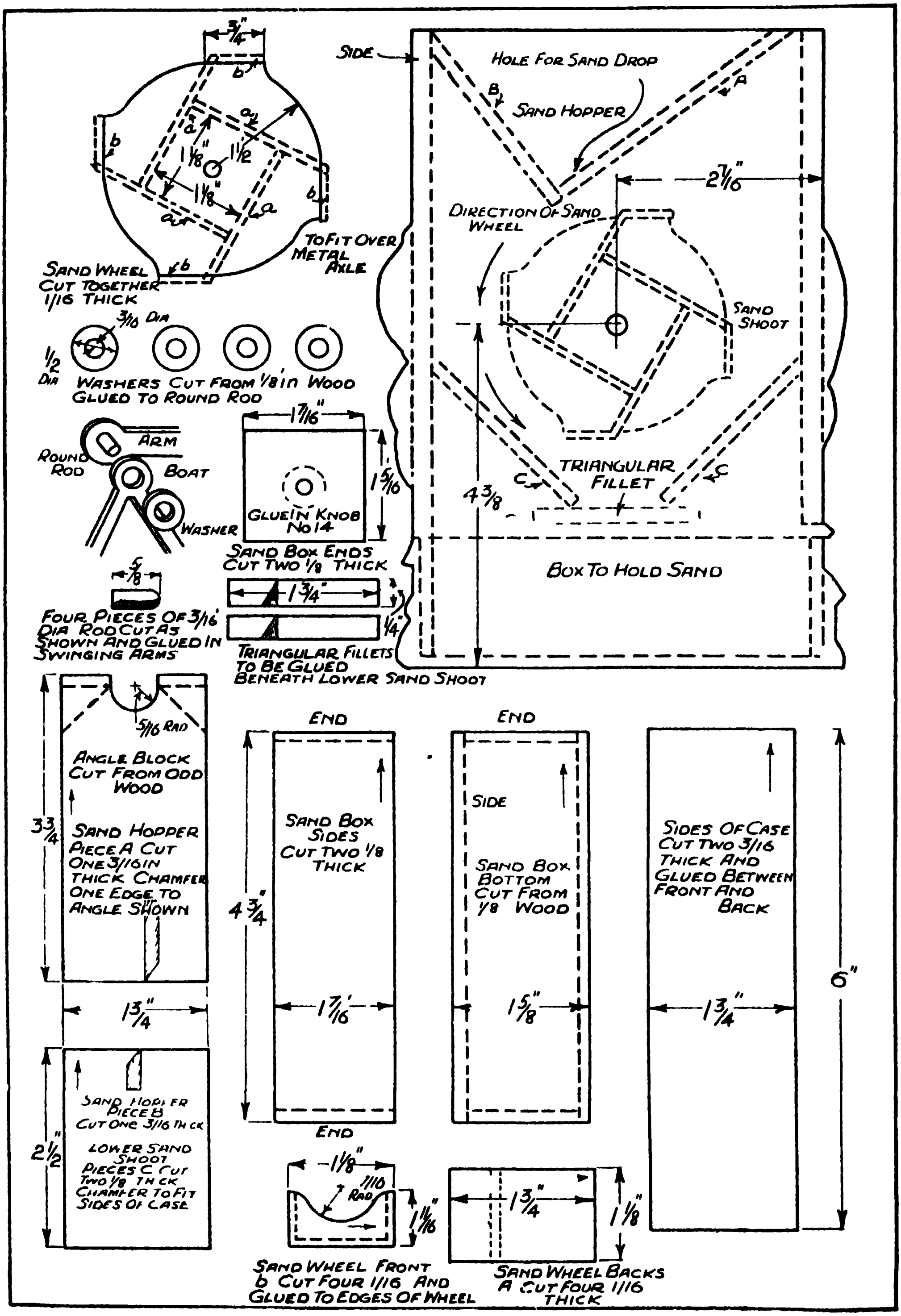
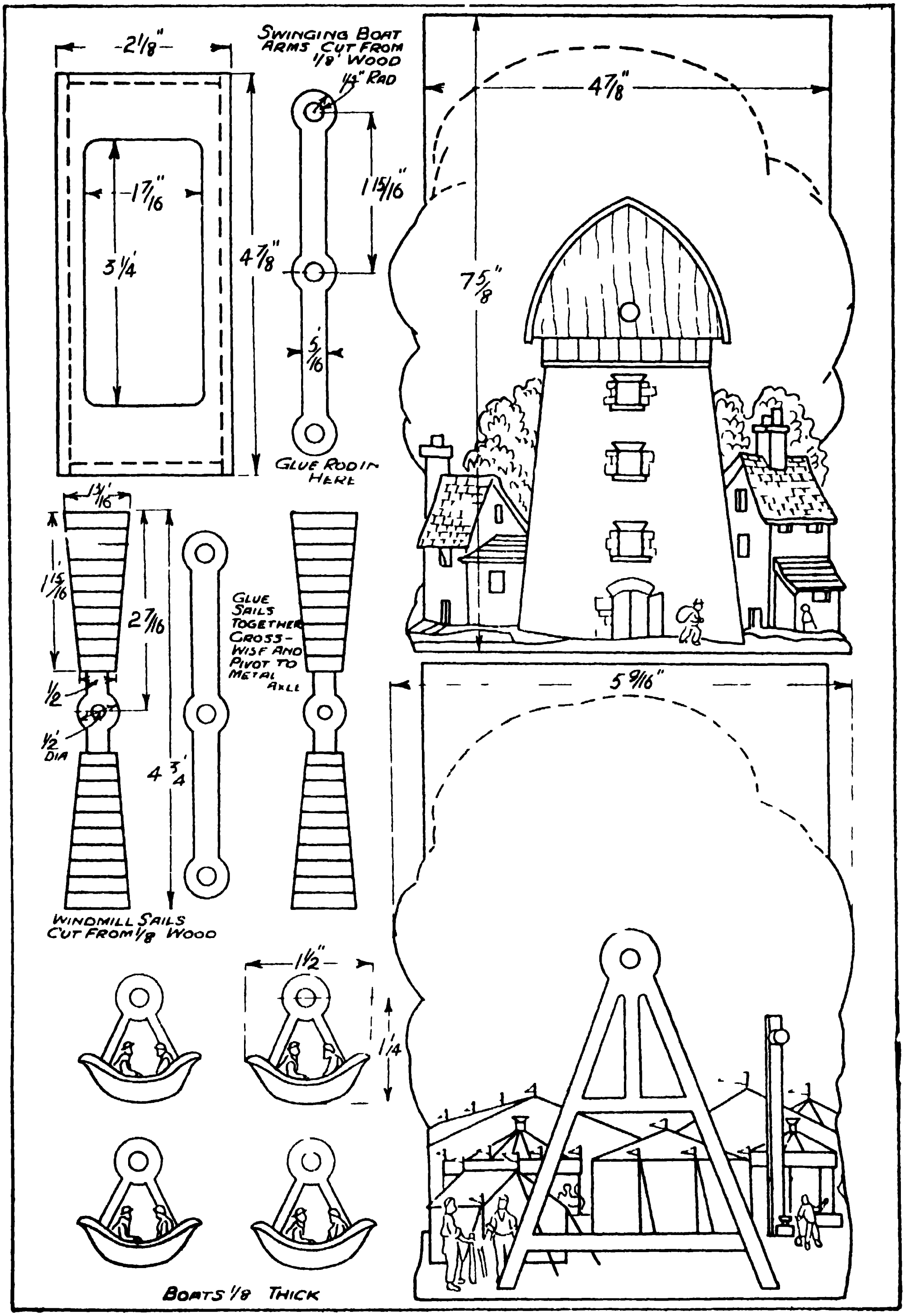


FIG 3



2 1/8"
4 7/8"
1 7/16"
3 1/4
Swinging Boat Arms Cut From 1/8' Wood
1/4" Rad
1 15/16"
5/16
Glue Rod In Here
4 7/8"
7 5/8"
1 3/16
1 15/16
2 7/16
1/2
1/2' Dia
4 3/4
Glue Sails Together Cross-Wise And Pivot To Metal Axle
Windmill Sails Cut From 1/8 Wood
5 9/16"
1 1/2"
1 1/4
Boats 1/8 Thick

FIG. 4

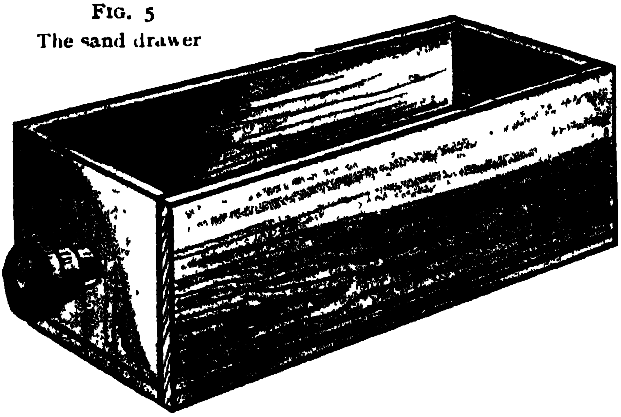


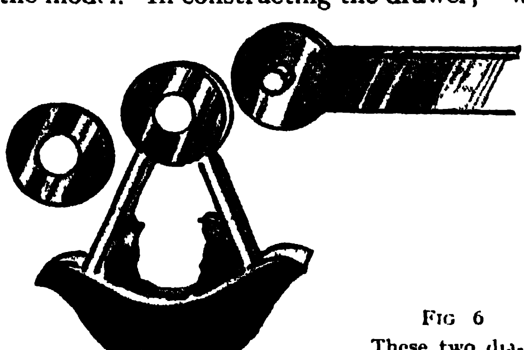
FIG. 5
The sand drawer

C which form the chute. When the sand has left the box, it runs down this chute into the drawer at the bottom. This drawer can be taken out, and the sand returned to the hopper above. The two chute pieces can be seen in Fig. 3, and – as in the case of the hopper – fillet pieces are glued to the back and front to carry the sand towards the central hole. These fillet pieces are cut from $\frac{1}{16}$-inch wood, and have the top face sloped down towards the hole before they are glued in place on the back and front. A picture of the drawer into which the sand falls is shown at Fig. 5. It is made of five parts all cut from $\frac{1}{8}$-inch wood. The two sides are glued on the bottom, and then the two ends put between. Little corner blocks can be added inside if required to give strength. Each end of the drawer is provided with a small knob to make it easy to take out from the model. In constructing the drawer, see that it will slide through the aperture in the sides before finally gluing it together.

The Sails

The movable sails of the models (Fig. 4) are, of course, fixed to the spindle which passes through the sand wheel already made up. This spindle projects at the back and front, and is held in place by a metal washer screwed on. On the outside of this washer, both at the back and front, are the sails and arms which revolve. In the case of the mill, they are merely two plain pieces glued together at right angles and held on the spindle by being forced on through the central hole.

The swinging-boat arms are completed in the same manner, but have the addition of the loose boats which hang at the ends of them. At the end of each arm is glued a $\frac{1}{2}$-inch length of $\frac{3}{16}$-inch round rod. The swinging boat itself hangs on this rod, and must have the hole cut at the top sufficiently large to allow it to swing easily as the arms rotate. The boat is prevented from slipping off by a small wooden washer cut from $\frac{1}{8}$-inch wood and glued to the end of the projecting rod (see Fig. 3). When the arms go round, the weight of the boat should be sufficient to keep it always level. A realistic effect is obtained if the picture is coloured in with water paints or poster colours.



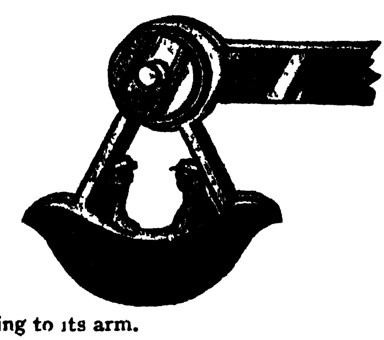


FIG 6
These two diagrams show the swinging boat before and after fixing to its arm.

THE BOY THROUGH THE AGES

In this picture we see Marcus, a Roman boy in the days when Britain was part of the great Roman Empire. Many Roman officials and their families lived in the cities they built in this country. Marcus went regularly to school and learnt to count on the abacus, seen in the picture. There was no glass in the window, and writing was done with a stylus on parchments which were later rolled and placed in a case.

TAKING TRIBUTE TO THE TITHE BARN

Leofric was a boy who lived in England during the Saxon period and in this picture we see him with the other villagers taking the tribute or tithe which was paid to the Church. From about the time of Bede this payment of tithes, the tenth part of the produce of the land or of other work, became part of the established customs of the country, and continued through the centuries Leofric is carrying a little pig as his parents' contribution

LIFE IN THE THIRTEENTH CENTURY

The boy who is the central figure in this picture was named Roger He is making his way to Parliament with his master. At this period, in the days of Henry V, Henry VI, and Edward IV, wheels were used only on rough tumbrils for the carrying of farm produce The majority of people travelled on horseback, and the goods of the country were mainly transported by pack-horse Only the very elderly or infirm used litters such as the one seen on the left of the picture.

AN APPRENTICE WORKS AT THE LOOM

Giles, who lived in the fifteenth century, was happy to become an apprentice to a weaver in order to be taught how to make cloth on a loom, taking the crosswise threads with a shuttle in and out among those that ran the long way of the piece. His master belonged to the guild of his trade, which had made this country famous for its cloth-making. These guilds and their system of apprenticeship produced the most highly-skilled craftsmen in the world.

HUMPHREY VISITS THE THEATRE

Humphrey belonged to the spacious days of Good Queen Bess—the time of Walter Raleigh, Martin Frobisher, Francis Drake, and other great sailors whose names have come down to us in history. One of Humphrey's chief delights was to be allowed to pay a visit to the Globe Theatre in London to see performed the plays of Master William Shakespeare. Here, for example, he is most thoroughly enjoying the presentation of *A Midsummer Night's Dream*.

SAILING FOR LIFE IN A NEW LAND

Here we see Jabez, who was a member of a Puritan family The Puritans rose in the sixteenth century, but were oppressed by the Stuarts, with the result that many of them left for America, there to establish new homes. In the picture we see Jabez with his father and mother, brother and sister, setting off from the quay for the galleon in which they were to brave the perils of the Atlantic and whatever unknown dangers might await them in the new lands beyond the ocean.

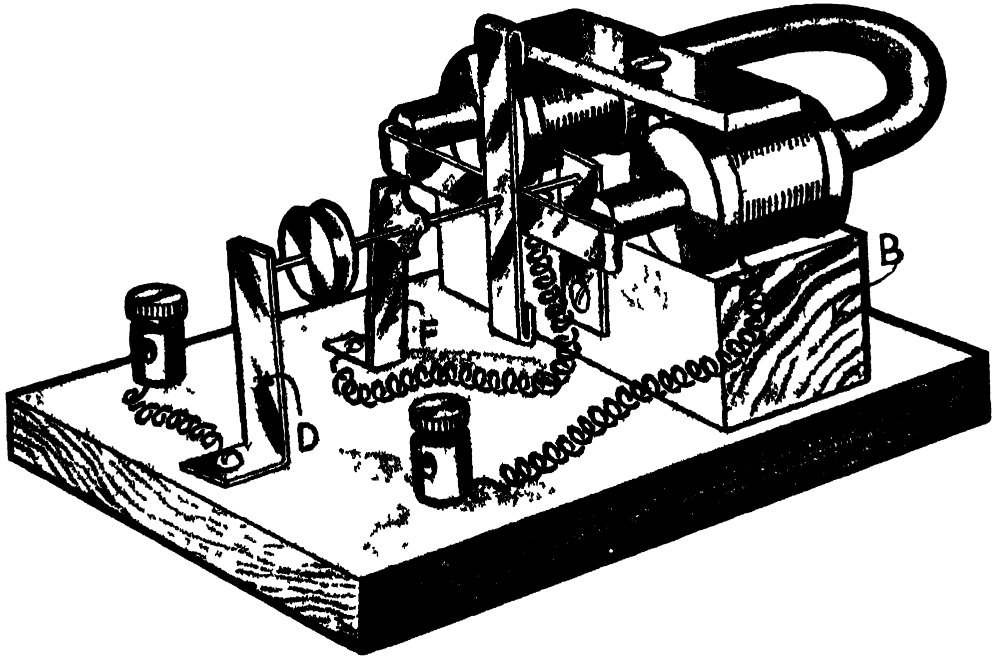
HOMEWARD BOUND FOR CHRISTMAS

Travel by stage coach became more general in the 18th century as the surface of the roads between the towns was improved Here we see John in the year 1720, it had been arranged that he should travel from London to spend Christmas with his family at Cambridge. Snow lay deep on the country roads and every seat on the coach was booked John had to ride uncomfortably in a basket at the back a receptacle which came to be known as a "boot"

THE FIRST PASSENGER STEAM TRAIN

Tom was brought up in Manchester, and it was his good fortune, in 1830, to see the first passenger-carrying train on the railway-line between his home town and Liverpool. Here he is standing beside the track, waving excitedly as the engine clangs its way along. At the rear important people are riding in their own carriage, which has been placed on a flat-topped truck. The earliest third-class carriages were not covered in and it was not till after 1844 that passengers were entitled to have a roof over their heads.

A SIMPLE ELECTRIC MOTOR



THE MOTOR ASSEMBLED

Here is another model which, though made up from the most commonplace materials, will work efficiently provided the instructions given below are carefully followed. The magnet is made from a large iron staple.

THIS little motor, made of extremely simple materials will work very satisfactorily if the various parts are carefully put together. It consists of an electro-magnet at the ends of which an armature, in the form of a cross, is caused to rotate. By means of a contact-breaker on the armature shaft the circuit is broken at the right moments so that the armature revolves continuously, and at a rapid rate, while connected to the battery. It will drive your models, too.

The Electro-magnet

First of all obtain a stout iron staple, such as can be purchased from an ironmonger's shop for about twopence. Get one about 3¼ inches long and 1¼ inches wide so that when the points are cut off with a hacksaw the magnet will have the dimensions given in Fig. 1. The ends of the magnet must be filed smooth and flat.

You will notice on referring to the illustration given above that the magnet has two coils of wire, one on each limb. The wire is wound on bobbins which are made by wrapping a strip of thin brown paper 1 inch wide, round each magnet limb and sticking the edges down with glue so as to form two paper tubes. Now make four washers of stiff cardboard or thin fretwood and glue one of these on to each end of the tubes. One of the finished bobbins is shown in Fig. 2. Fig. 3 indicates the direction of winding.

Winding the Coils

After the glue has set, proceed to wind the magnet coils, using No. 26 gauge double cotton-covered copper wire. About 6 yards of wire will be required for each coil. Wind on the wire as closely and evenly as possible, and when half the wire has been wound on one bobbin, tie a piece of strong thread round the last two turns to keep

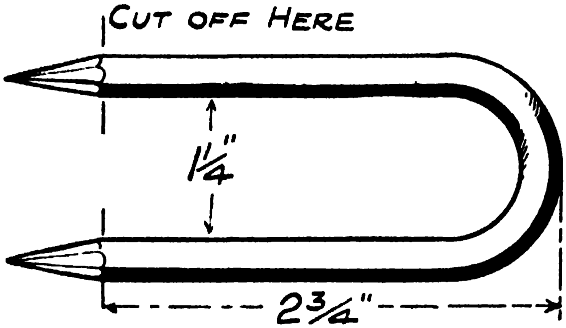


FIG. 1

The staple to use for the magnet showing the portions to cut off.

the wire from unwinding. Now cross the wire over and wind in the reverse direction on the other bobbin. Leave about 8 inches of free wire at each end for connecting-up purposes. You will see by Fig. 3 how the wire is crossed over from one coil to the other. Make sure of this.

Armature and Spindle

The armature can be made next, and for this cut two strips of thick tinplate (A, Fig. 4) and round the ends with a file. In the middle of each strip drill a small hole, bend over the ends and pinch together with pliers.

Now prepare the armature spindle, which may conveniently consist of a 2-inch length of ordinary steel knitting needle with the ends filed conical. Press the armature arms on to the spindle at ½ inch from one end and at right angles to each other. Adjust them carefully at right angles to the

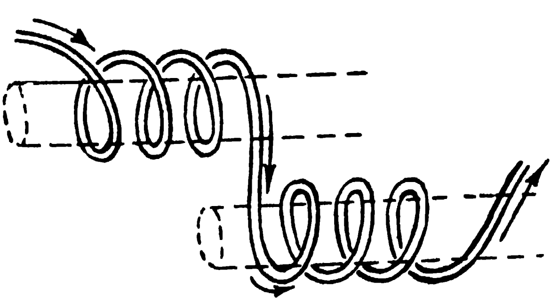


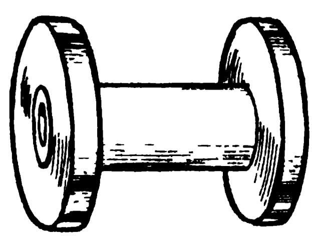
FIG. 3

The two bobbins should be carefully wound in opposite directions, as shown here.

spindle and solder them in position. The little contact-breaker (E, Fig. 5) can be filed to shape from a piece of sheet brass ⅜ inch square, a hole being drilled in the centre a tight fit to the spindle. Round the corners carefully with a fine file, and then press the contact-breaker on the spindle about ¾ inch from the back of the armature, soldering it into place as explained later.

Baseboard and Bearing Plates

At this stage it will be as well to prepare the baseboard. Plane a piece of wood 5 inches long by 2¾ inches wide, and ⅜ inch thick, and bevel the top edge all round. A rectangular block of wood, B (p. 369), can also be made for supporting the magnet. This block, which is 2 inches long by 1¼ inches by ⅞ inch, can be fixed by two screws driven in from underneath the baseboard.



FIG

How to make the bobbins which pass over the two ends of the staple.

From a strip of thin sheet brass ⅜ inch wide and 3⅛ inches long, cut off a piece 1 inch long. In this piece drill two holes as shown in Fig. 6, and near the top edge make a deep centre-punch mark. One end of the other brass strip can be bent at right angles on the dotted line after the two holes are drilled in the lower part as indicated. A deep centre-punch mark should also be made near the top end of this plate on the opposite side to that on which the bent foot projects (see Fig. 6).

Assembling the Parts

Having got so far, we can now begin to assemble the other parts of the motor. Clamp the electro-

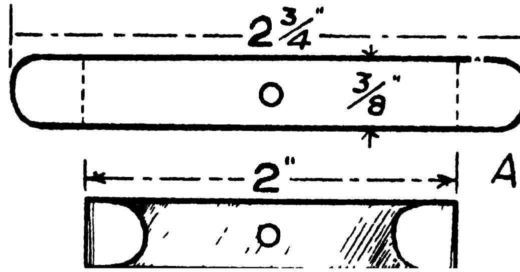


Fig 4
How to make the armature arm

magnet firmly in place on top of the block B by means of a thin strip of wood and a stout screw, allowing about ½ inch of the ends of the magnet to project beyond the face of the block B.

The two bearing plates can be screwed in position and adjusted so that the spindle runs quite freely and is parallel to the baseboard. When the spindle is revolving, the bent-over parts of the armature should clear the ends of the magnet by a bare 1/16 inch, and the magnet can be finally adjusted to bring this right

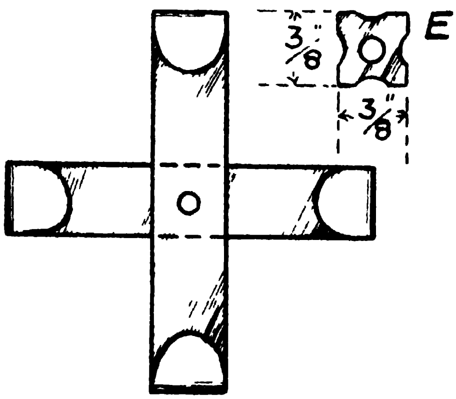


Fig. 5
The completed armature

by slightly turning the holding-down screw.

We shall now require a strip of very thin, springy brass about ⅜ inch wide and 2 inches long for the contact brush, F (p. 369), which should be cut to a slight taper. Bend the bottom part at right angles, drill the two small holes, and then screw it down to the baseboard opposite the little contact-breaker, so that it presses lightly against the rounded corners of the latter when it revolves. Take care to see that the corners are quite smooth and that they all make contact with the brass brush.

Making the Connections

After screwing two terminals in the baseboard, we connect up the wire from the magnet coils. The end of the wire from one coil is clamped down under the head of one of the screws which fix the brush to the baseboard; while the end of the wire from the other coil is screwed down under one of the terminals, as shown on p. 369. The other terminal is connected to one of the screws of the bearing D.

The little motor is now ready for connecting up to a battery, and this may consist of two small bichromate cells. After giving the armature a turn to start it, it should revolve at a rapid rate if the contact-breaker is carefully adjusted so that it is just breaking contact with the brush when either of the two arms is directly opposite the ends of the magnet. When the correct position is found, fix the contact-breaker with a touch of solder. If required, a small pulley wheel can be fixed on the shaft.

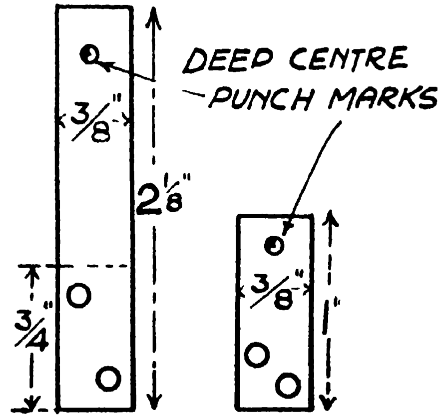
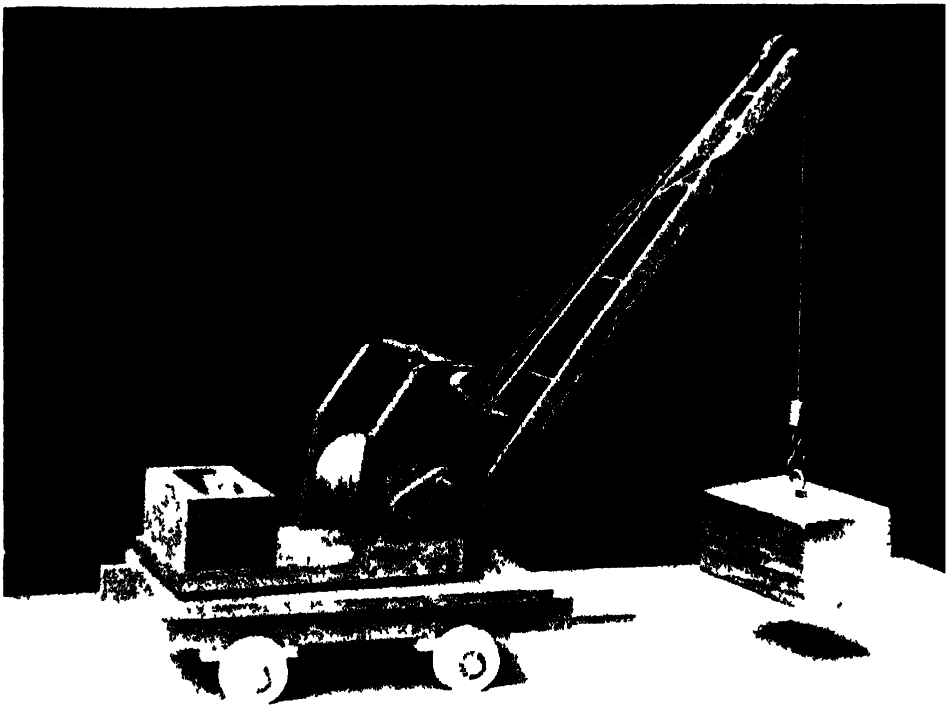


Fig. 6
Details of the bearings

A MODEL TRAVELLING CRANE



READY FOR USE

FIG 1 This illustration shows clearly what a strong and serviceable model can be made following the few simple and clear instructions given in the text

THIS strong and instructive toy shown in Figs 1 and 2 can easily be made from odd pieces of wood, a cotton reel and a wooden knitting needle The main platform is made from a piece of wood measuring 7½ inches by 4½ inches by ½ inch in thickness.

Next the underside of the platform is made to the dimensions shown in Fig. 3 The platform is shown assembled in Fig. 4. The wheels are made from a cotton reel and are ½ inch thick The axle consists of pieces of a wooden knitting needle, two 5½ inches in length being required. The bearing blocks can be cut to the shape shown in Fig. 5 and holes drilled for the axles

These holes should be quite a tight fit to the axles as the latter do not revolve, the wheels being loosely mounted to revolve on the end of the axles, and are held in place by means of a washer.

Swivelling Platform and Ballast Box

A piece of wood will be required, measuring 5½ inches by 3½ inches, which should be planed on both sides till it is $\frac{5}{16}$ inch thick, after which drill a $\frac{5}{32}$ inch hole on the centre line and 1⅞ inches from one end, for the pivot pin.

The ballast box, to be seen at the rear of the platform, is now made from a piece of wood measuring ⅜ inch thick and 1½ inches wide ; cut off two pieces

2¼ inches long, and two pieces 1⅞ inches long, and nail them together forming an open-ended box, which can be fixed to the platform as shown in Fig. 2. The side frames are now made as shown in Fig. 6.

Next make the jib as shown in Fig. 7. A venetian blind pulley will answer very well for the pulley, and for the shaft a ⅛ inch diameter screw will be required, 1 inch long under the head and threaded at the end for a distance of ⅜ inch, this end being screwed into the side piece of the jib, the end projecting sufficiently to allow a nut to be screwed on as indicated.

Winding Drum

As will be seen by reference to Fig. 2, the winding drum consists of a cotton reel of a length to allow it to fit easily between the side frames, so permitting a little side play. Two brads can be used for fixing the shaft as shown, the latter projecting about ½ inch on one side to take the winding handle. The crank part of the handle may be cut out to the dimensions shown in Fig. 8. The other part of the handle may be conveniently formed from a wood screw.

From an Old Alarm

The shaft round which the chain for raising and lowering the jib is wound should be provided with a ratchet wheel and pawl, and those taken from the winding gear of an old alarm clock can be used. These ratchets are usually provided with a sleeve, and this affords a convenient means for attaching to the chain shaft of the crane, a hole being made in the sleeve and a small screw then driven into the shaft as shown in Fig. 2.

The handle for this can be made in a similar manner to the one on the winding drum shaft, and the pawl can

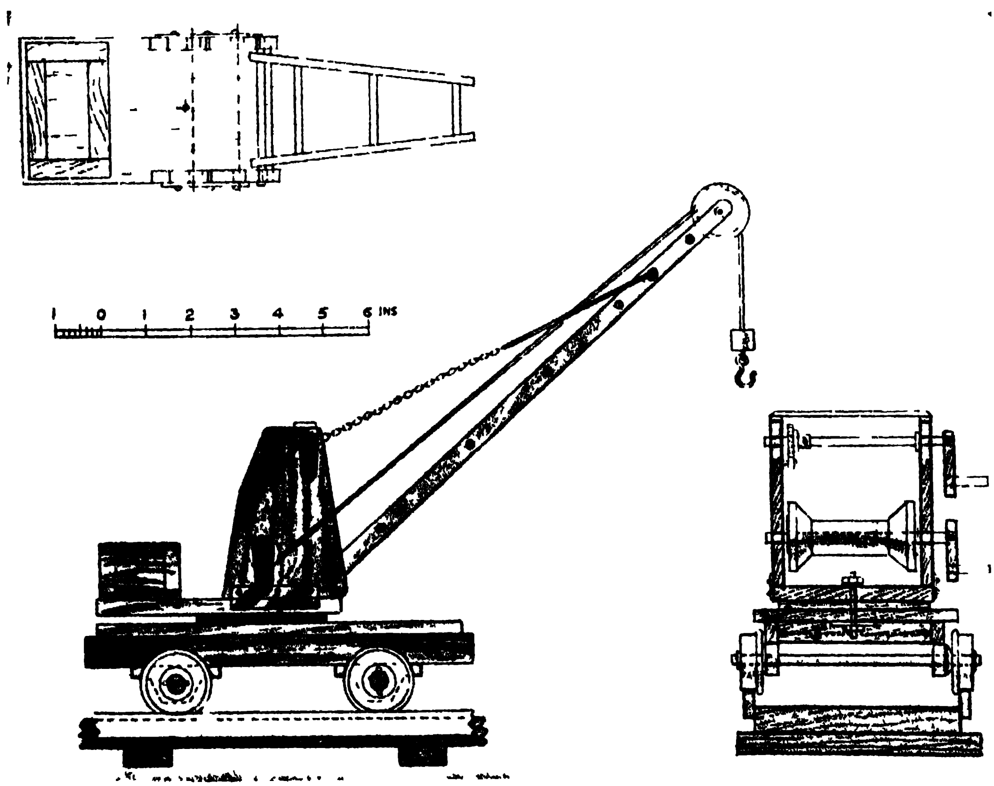
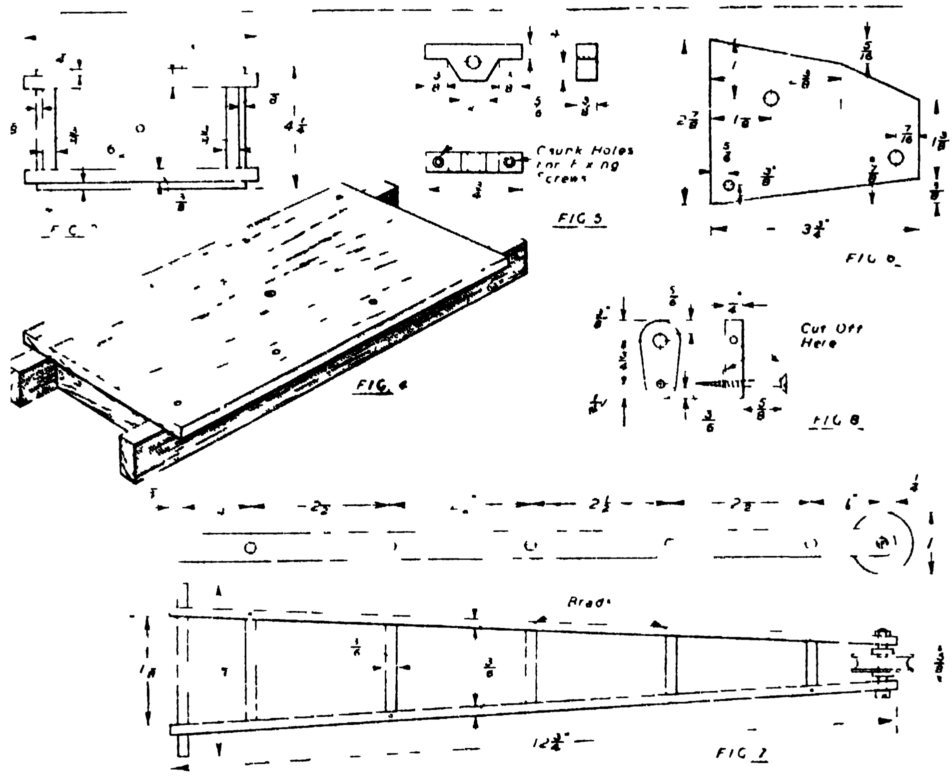


FIG. 2. Plan and Side and End Elevations of the Model Travelling Crane.



FIGS 3 to 8 —Various constructional details of the Model Travelling Crane.

be screwed to the side of the frame as shown in Fig. 2.

The chain is attached to the shaft by means of a small screw, while the other end is joined to a connecting brace-piece, which is bent to shape from an 8-inch length of wire, the end being formed into loops and screwed to the sides of the jib as shown in Fig. 2. For the winding rope, fine string may be used. On the other end of the rope a suitable lead weight can be attached, together with a hook.

Making the Turntable

It will be noticed that the side frames or cheeks are fixed to the swivelling platform by means of rectangular plates. These are of sheet brass, measuring $2\frac{1}{8}$ inches by $\frac{5}{8}$ inch, $\frac{1}{8}$ inch holes being drilled to take the fixing screws. Across the top of the side frames a strip of wood $\frac{1}{8}$ inch thick by $\frac{1}{2}$ inch wide can be screwed in place to act as a stay. A disc of wood, 3 inches diameter, can be cut out from a piece of fretwood $\frac{1}{8}$ inch diameter to act as a turntable, a $\frac{5}{32}$ inch hole being drilled in the centre to allow the pivot pin to pass through.

Final Details

This pin consists of a screw $1\frac{1}{8}$ inches long under the head, threaded for $\frac{1}{2}$ inch at the end and provided with a large and small washer and nut as shown in Fig. 2. The running rails can be formed of strips of wood, $\frac{3}{8}$ inch wide and $\frac{1}{16}$ inch thick, screwed or nailed to a suitable length of wood, $4\frac{1}{2}$ inches wide and $\frac{1}{2}$ inch thick, which, in turn, may be fixed to sleepers.

The finished toy can be painted with enamel in one or two colours.

Favourite Hobbies: Things To Make and Do

Handcrafts of Many Kinds

Photos specially prepared for this work

TWO FAITHFUL SERVANTS YOUR HANDS

Some boys and girls hope that one day they will drive a powerful car, an aeroplane or a motor-boat. It is the ambition of others to ride a horse or excel in playing a musical instrument. You may have the opportunity in the future to do one or more of these fascinating things, but, if you are to become proficient, it is as well to remember that you must spend the waiting time in training your hands. A clever pair of hands is a priceless possession, and in the following pages you are shown many delightful methods of training your fingers to be sensitive and dexterous and useful to you in many ways.

HANDCRAFTS

LONG ago it was extremely necessary that everybody's hands should be trained to be useful. People who could not use their hands in those days could not have kept themselves alive at all.

Before a child could have clothes, for instance, it was necessary that the father should go out and shoot an animal to get its skin (and before he did that he had to make the bow and arrows).

In some countries it is still necessary for the inhabitants to supply most of their own needs, but even if they spend all their life in a country where it is possible to live without doing so, people who learned when they were young to use their hands are indeed fortunate.

Not only are things made by hand more worth while than those made by machinery, but when a person is interested in handcrafts, visits to museums and art galleries, and travelling in our own and foreign lands, all become means whereby new ideas may be found, and reading and the whole of life thus become more interesting.

A very important thing to remember is that if a child allows his hands to grow up useless he will never be able to train them afterwards. It is only when hands are young that they can learn.

Age 3 Years

BEAD THREADING

Materials :—

Large, Coloured Beads.
Thick Embroidery Cotton.
No needle.

Method

This is begun by tying a bead on to one end of the thread. The child should be encouraged to do it himself. He can never have skilful fingers if bigger people are constantly helping him.

The beads should be threaded in any of the designs on this page (Fig. 1), or the child can make up his own designs. Great care should be taken to make them correctly.

When the string of beads is long enough, the two ends should be joined. Bracelets and necklaces can be made as presents.

There is another method, suitable only for older children, as a needle is required.

Thread several beads on to the middle of a cord with a needle at either end.

Add the same number of beads, putting the thread through the row first from right to left, then through the row from left to right. Many good designs may be worked out.

RAFFIA WINDING

Materials :—

Cardboard Ring.
Plain and Coloured Raffia.

Method

Soak some thick strands of raffia in water for several hours. Take one strand and smooth it out flat. Hold one end of this strand on the front of the cardboard ring with the left thumb (Fig. 2), then wind it over the ring, covering the end with the first wrapping, and making each wrapping overlap the one before it.

When the ring is all covered, the other end should be tucked inside several wrapping strands and the whole kept in place with a strand of coloured raffia tied in a bow (Fig. 3).

Picture frames may be made for the doll's house in raffia. Take a circle of cardboard the size of a saucer, with a smaller circle cut out of the centre. Cover this in the same way as the ring.

A round box may be made by covering a ring and a circle the same size (with a very small hole in the centre) and sewing the ring on to the circle. Another covered circle may be used for the lid.

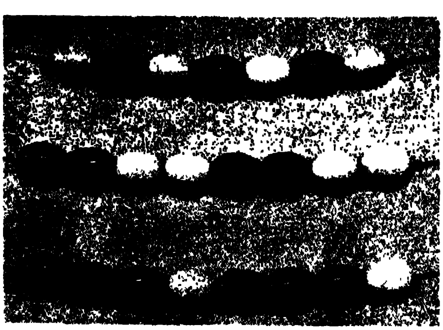


FIG. 1

Here are three ways in which beads may be strung by a small child. If the child prefers to make other number combinations he should do so.

FIG. 2 FIG. 3

Above can be seen the method of starting to cover a ring with raffia. Fig. 3 shows the ring completed. Other things which can be done with raffia are described above.

Age 4 Years

WOOL WEAVING ON CANVAS

Materials :—

A piece of Rug Canvas.
Thick, Coloured Wool.
A Raffia Needle.

Method

Cut the canvas four squares larger in both directions than is needed for the finished article Fold over two squares all round to make a neat edge

Using the wool double, darn in at one square and out at the next all the way across, going through the double thickness at the ends The second row of darning should cover the alternate squares (Fig 1)

The darning can be done all in one colour or in stripes, or coloured borders (using the tacking stitch designs) can be worked by older children

Mats, dolls' carpets, covers for blotters, kettle holders and other useful things can be made.

WOOLLY BALLS

Materials :—

Cardboard.
Scissors with rounded points
Coloured Wool.

Method

Draw a circle about 3 inches across on the cardboard, using a cup or the lid of a tin Draw another circle with a halfpenny in the centre of this Cut these pencil lines with scissors Make two of these cardboard circles

Take several strands of wool Hold the ends in front of the cardboard with the left thumb and wrap the wool through the hole and over the edges (Fig 2) Work all round the circle, joining on new wool when necessary When the hole is nearly filled up cut the wool as in Fig 3 on the next page When the wool is cut, put a piece of strong string round between the two pieces of cardboard and tie it tightly Pull off the cardboards and trim the ball neatly with scissors

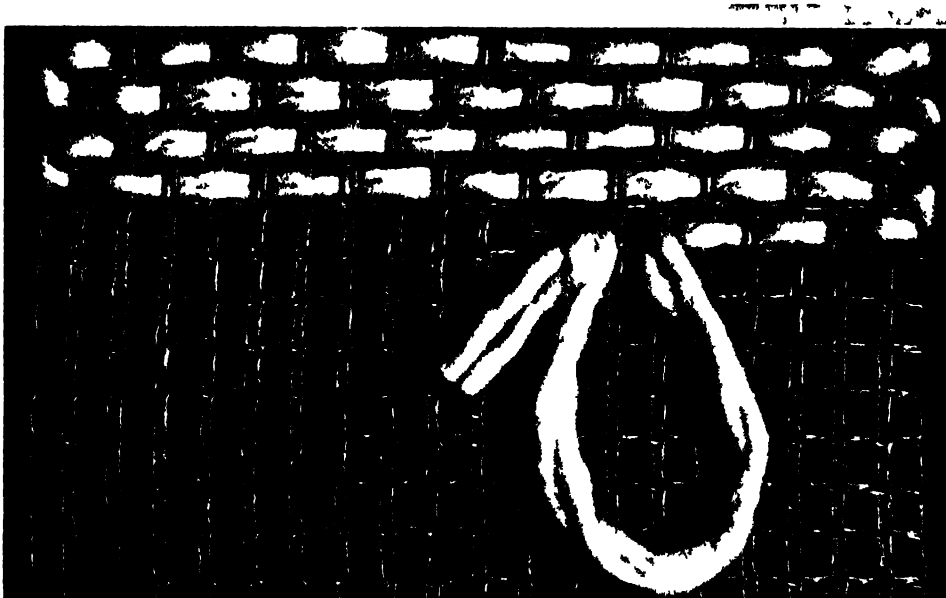


Fig 1

Above a part of a doll's rug is seen in process of being woven Thick wool is used doubled and a large eyed blunt needle The four year old should choose his colours himself He should also have a definite idea of what he is making and its use before he begins

HOW TO MAKE A WOOLLY BALL

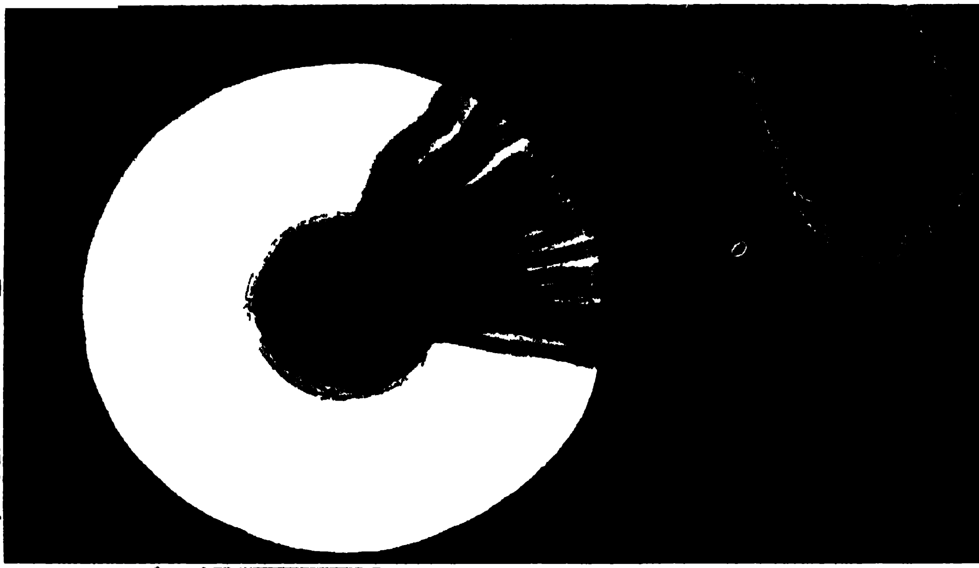


Fig. 2 shows clearly how to start making a woolly ball. One colour or several different colours may be used. Older children can get good effects by making each round a different colour so that the finished ball is striped. If the child makes the ball for a young brother or sister, let him tie it with elastic leaving a long end which can be fastened to baby's pram. This makes a splendid plaything.

In Fig. 3 it can be seen how the woolly ball is cut. The space between the cardboard, where the string to tie the ball goes, is also seen. Two yellow balls make a chicken. The legs (a piece of millinery wire bound with yellow wool, with the toes separate) are inserted through the hole in the larger ball before the wool is cut, and the smaller ball is attached for the head. A match and ink spots form beak and eyes.

Age 5 Years

PLAITED RAFFIA

Materials :—

Raffia.
Raffia Needle.

Method

Take three strands of raffia. Knot them together at the top and pin them down securely with a drawing pin to a table. Take the strand on the right, pass it over in front of the middle strand. It is the middle strand now. Take the strand on the left and pass it over in front of the middle strand. Then the one on the right, then the one on the left.

When the plait is about 2 inches long add another strand to each of the three, and after another 2 inches add a third strand to each to make a thick plait

When a new strand is added leave the end sticking out (Fig. 1) When each strand is finished, add a new one in the same way. Make a plait several yards long, tie the end and clip off all the loose ends along its length.

Thread a thin strand of raffia on a needle. Wind the end of this round the thin end of the plait and secure it with a stitch. Cut off the knot, and coil the plait round on a table to make a mat. Sew each coil through from the side as in Fig. 2. Do not let the stitches show. Cut the strands off at the other end to make the plait narrow gradually. Finish off by sewing the end down securely and cut off the knot.

Coloured raffia can be plaited in with the other to form a border on the last row or two.

Useful mats may be made in this way, and can be either oval or round in shape.

A simple basket may be made by sewing two mats of equal size together, half-way round, at their edge. The handle can be a raffia plait with the ends knotted and fringed out to form a tassel.

Another shape of basket may be made by sewing the plait round as for a mat until the base is the right size, then raising the side in the method described in Indian Basketry (see p. 387, Fig. 3).

Dolls' hats, and furniture for the doll's house can all be made when the method has been mastered.

Fig 1 shows the start of a raffia plait, with each new piece left sticking out, to be trimmed off afterwards. Fig 2 shows how the plaited raffia is sewn together. Sew through only two rounds at one time.

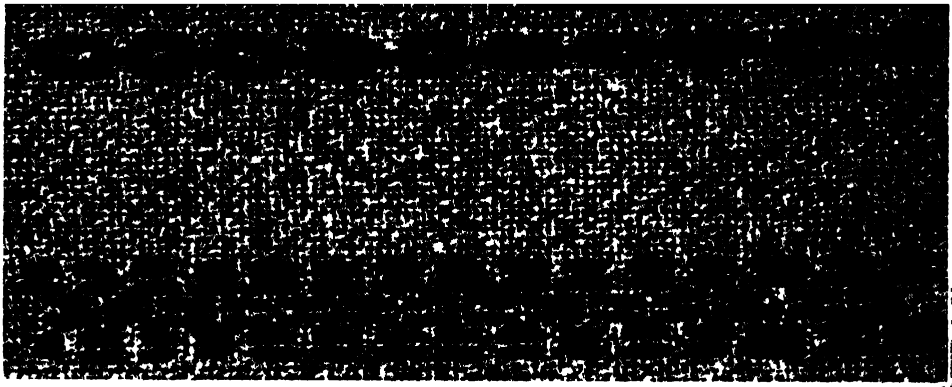


FIG. 3 (top). FIG 4 (bottom)

Fig 3 (at the top) is a nice simple design with which to start The two outside lines should be done first, and the middle line afterwards For small children, very thick cotton is desirable In Fig 4 the rows should be worked from the edge inwards

SEWING

Materials :—

Crash or any other strong material with a loose weave.
Thick Sewing Cotton in two Colours.
Crewel Needle.

Method

Thread the needle and make a knot in the other end of the thread. A knot can be made by winding the end of the thread twice round the forefinger of the left hand and taking a stitch through this, pulling it up tightly.

Now start sewing along the edge of the material, making the stitches all the same length, and keeping the space between them the same length. The design marked Fig. 3 on this page is a good one with which to start. Fig. 4 can be done next.

These designs look best with the out side rows in one colour and the middle rows in a different colour.

Handkerchief cases, nursery table cloths, hems of dolls' dresses and table mats can be ornamented in this way. The stitch is called tacking stitch.

If the child finds it difficult to sew on cloth at first, brown paper may be used.

A mat for a hot milk glass is a favourite article on which to begin.

FRAME KNITTING

Materials :—

A Knitting Frame.
Thick Wool or Twine.

Method

A small frame for making reins can be made from an empty reel. Knock six tin tacks round one hole leaving most of each tack standing up. Larger frames can be made on the same principle, provided there is a space in the middle for the knitting, or the frames can be bought ready made, with wooden pegs instead of tacks.

Make a loop on the end of the wool. Slip this over one of the pegs. Now wind the wool round each peg in turn, taking it round the back, across the front, round to the back again and on round the back of the next peg. Wind it all round twice. Slip the lower stitch over the top of the other and off the peg on the last peg to be wound. This keeps the work from unravelling. Now slip the lower stitch off on each peg all round. Wind another row of stitches and slip off as before. Continue until the knitting is as long as required (Fig. 5).

Break the wool off about half a yard from the last stitch. Thread it on a

needle and take each stitch off the frame in turn with the needle, pulling the wool through.

The end can either be finished by pulling the thread up tightly and fastening the wool, or it can be left flat and the two sides sewn together. If a bag is to be made, make a cord with which to pull it up.

Scarves, caps and tea cosies can be made in wool.

Bags for tennis balls or golf balls can be made in twine.

To Make Cord

If one yard of cord is wanted, cut four strands (more for a thicker, fewer for a thinner cord) $2\frac{1}{4}$ yards long. The cord is more even if one person twists at each end, but it can be made by one person alone if the end is securely fastened to a fixture.

Knot the strands at both ends. Twist the strands between the finger and thumb, twisting always away from the body, until they are quite tight (Fig. 6).

Double the strands, holding the twist midway between the two knots (Fig. 7), and knot the cord under the two knots, which should then be cut off.

Cord made in this way is useful for a variety of purposes.

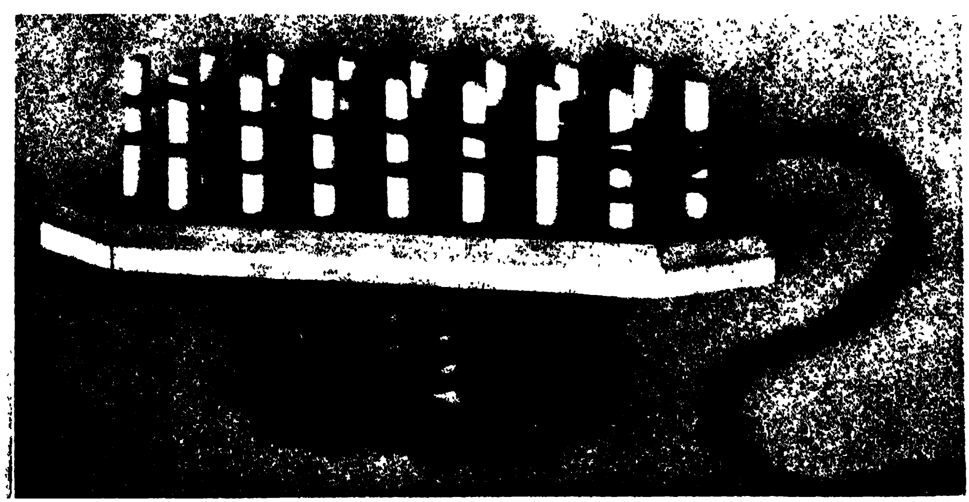
If it is to be used for twine bags it is best made of twine.

Woollen cord is used on a great many knitted garments, with the ends finished with small woolly balls or tassels.

Silk cord is useful for finishing cushion covers, tea cosies, work bags and many other articles. A tassel is the best finish for a silk cord.

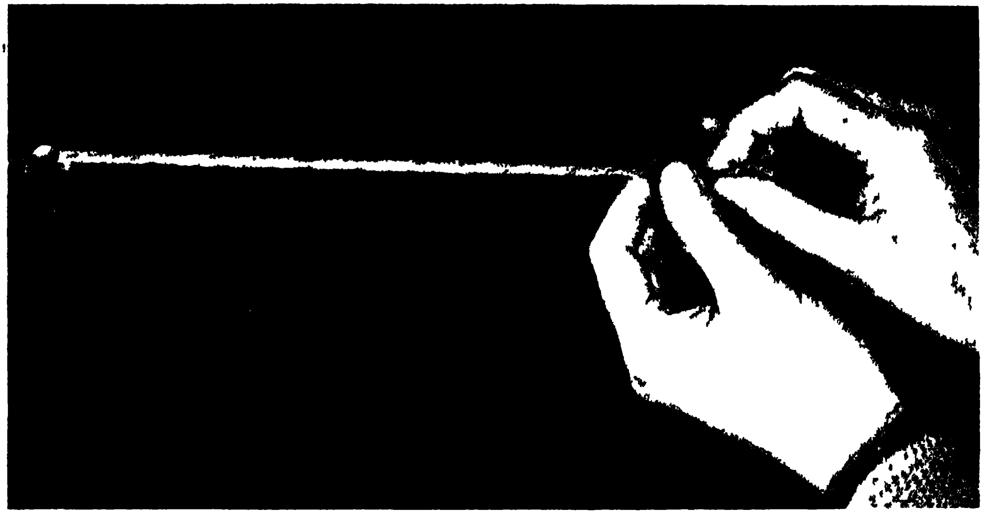
To make a tassel, take a firm piece of cardboard the same length as the finished tassel is to be. Wind the wool, silk or twine round this until the tassel seems fat enough. Bind the strands together at the top of the cardboard with the loose end of wool, and cut the strands through at the other end of the cardboard.

Gather the strands in one hand and bind them together again a little below the top. Sew the tassel to the end of the cord, and trim the other end with scissors.



This is how knitting is done on a frame. The peg that has only one stitch on it was the one that was wound last, so the bottom stitch was taken over the top one to keep the wool from unravelling. The finished part is seen coming out from the space in the middle of the frame. Only thick wool or string should be used on a large frame.

MAKING CORD



In Fig 6 a cord is being made by one person After the end has been firmly fixed the strands are twisted to the right Cords of any thickness may be made from quite thin ones of sewing cotton or silk to thick ones in wool The thin cords sewn along an edge of material make very good button holes if little spaces are left free at equal distances between the sewn down parts

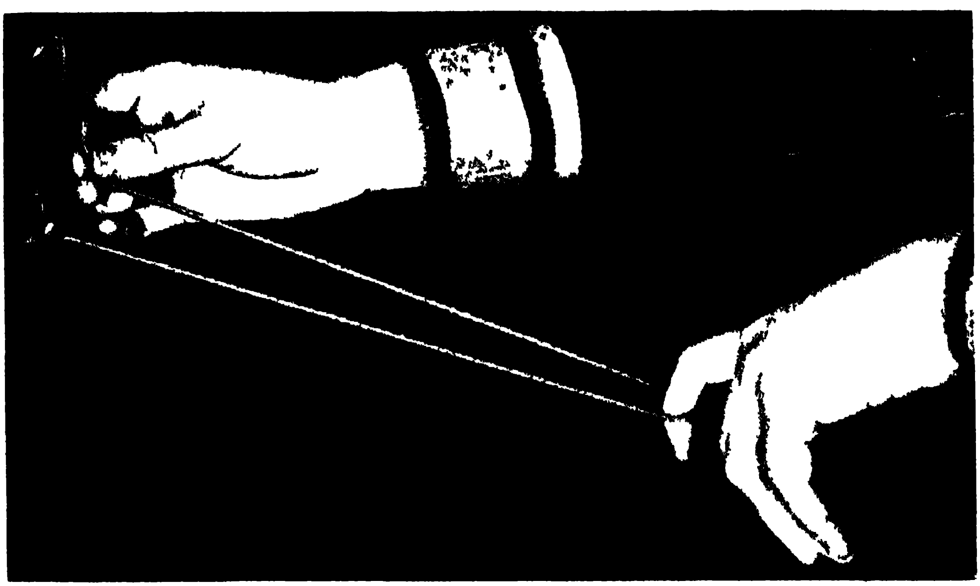


Fig 7 shows the strands twisted and doubled ready to be tied Great care must be taken to hold the twist with the left hand mid-way between the ends, as is shown in the picture, otherwise the cord begins to twist in the wrong place and is never quite so even afterwards Different colours may be used in one cord, or strands of silk and wool, or silk and cotton look well

Age 6 Years

SEWING

Materials :—

Cotton or Woollen Material.
Thick Wool or Cotton Thread.
Crewel Needle.

Method

This is the same as before, but now stitches that go up and down as well as those that go across can be learned. The designs in the illustration (Fig. 1, p. 384) are not meant to be copied. It is more interesting for the worker to make up her own designs.

When the article to be made has been decided on, choose the material and the colours of silk and wool to be used, then draw several designs in coloured chalks on paper and choose the one most suitable for the purpose intended. The designs in Fig. 1 will give some ideas.

These paper designs may be used as friezes for the doll's house, for covering cardboard boxes or for other decorative purposes.

Practice will thus be gained in making designs to fit corners.

It will also be a good way to gain ideas of colour harmony.

Even after the selection of colour has been made, the choice of which is to be used as background and which as decoration is still important. A safe rule is that the brighter the colour, the smaller should be the space it occupies. If we look at the world out of doors we find that the large spaces are filled with browns and greens, whilst the scarlets, bright yellows and purples have only a small place.

Shoe bags, tray cloths, curtain ends, chair-backs and cushions can all be ornamented in this way.

WEAVING ON A FRAME

Materials :—

Stiff Cardboard.
Ruler.
Pencil.
Scissors with rounded ends.
Thick Wool in two Colours.
Crewel Needle.

Method

First make the Loom on which to Weave

Cut a firm piece of cardboard 7½ by 9 inches. Lay a ruler along the top (short end).

Put a mark at 1 inch and another mark at each ½ inch until 6½ inches is reached (12 marks in all).

Now measure ¼ inch down from the top on each side and make a mark. Draw a line to join these marks.

On this second line put the first mark at 1¼ inches and another at each ½ inch until 6¼ inches is reached.

Draw a line from the first mark on the top line to the first mark on the second line and another from it to the second mark in the first line. Do this until all the marks are joined.

Turn the cardboard top to bottom and mark the second end in the same way.

With scissors, cut the marked notches out of both ends of the cardboard.

This is the loom. (See Fig. 2, p. 385.)

To Make the Shuttle

Take a piece of cardboard 8 by 1 inches.

Cut a notch 1 inch deep at each end, and a little slit in the side of one of these notches.

To Thread the Loom

Take a ball of wool. Leave about ½ yard of wool at the back of the loom. Bring the wool forward at A. Pass the wool down the front of the loom, round the first point at the bottom, back across the front and round the second point at the top. Continue this until all the notches are full. There should be eleven strands across the front of the loom and no wool at the back except the loops round the points between the notches, and the end to tie.

Take the wool to the back at B. Leave ½ yard and tie to the piece left at A.

The strands across the front are called the warp.

DESIGNS FOR TACKING STITCH

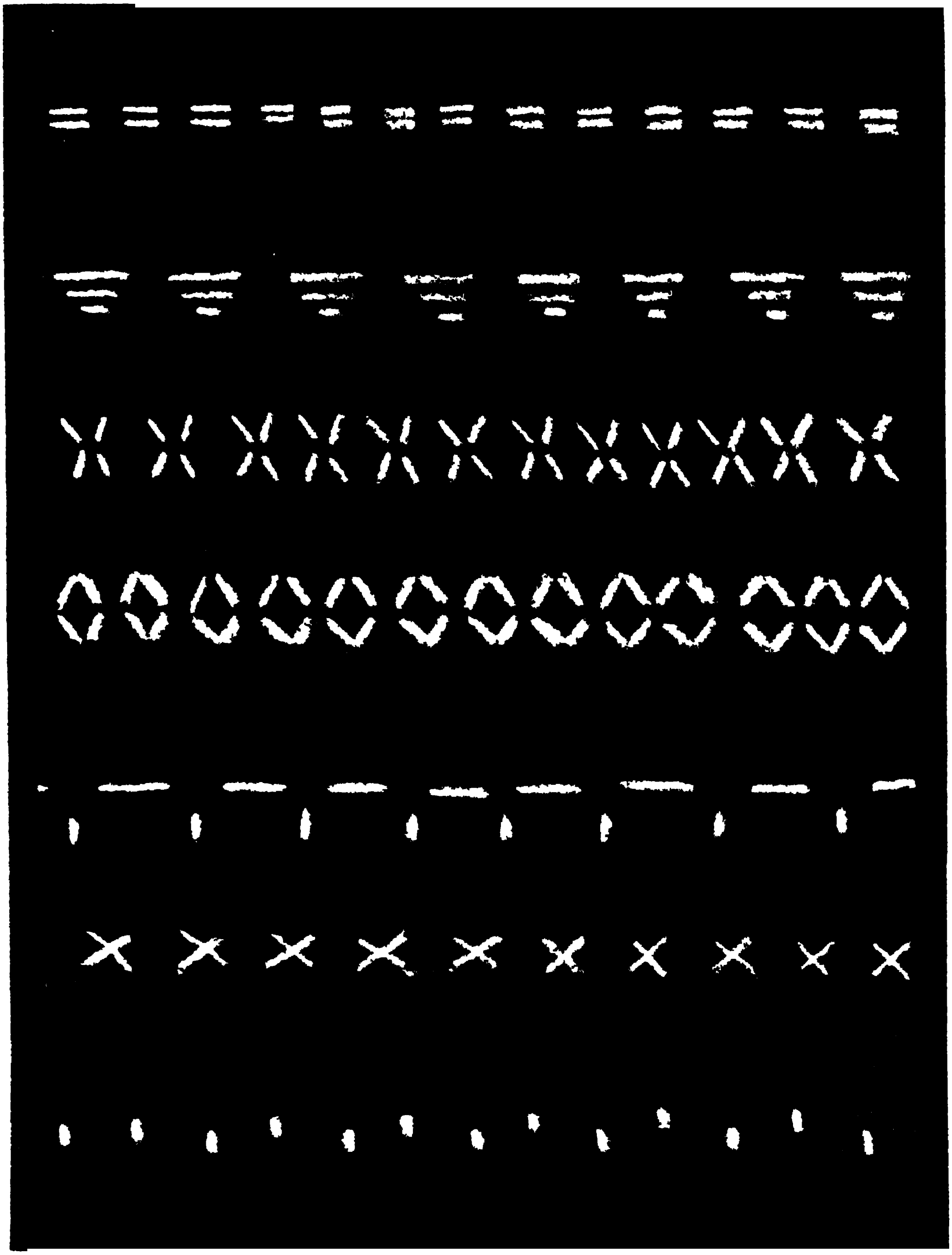


Fig 1 —These designs for the use of two colours on a third coloured background may be used for other purposes besides tacking stitch Pottery may be decorated with lines instead of stitches Wooden boxes trays etc , can be painted thus in strong colours or the designs may be used in weaving and basketry Some colour combinations that were found good were black and white on blue, black and yellow on grey, blue and green on grey, and green and coral on a natural-coloured linen

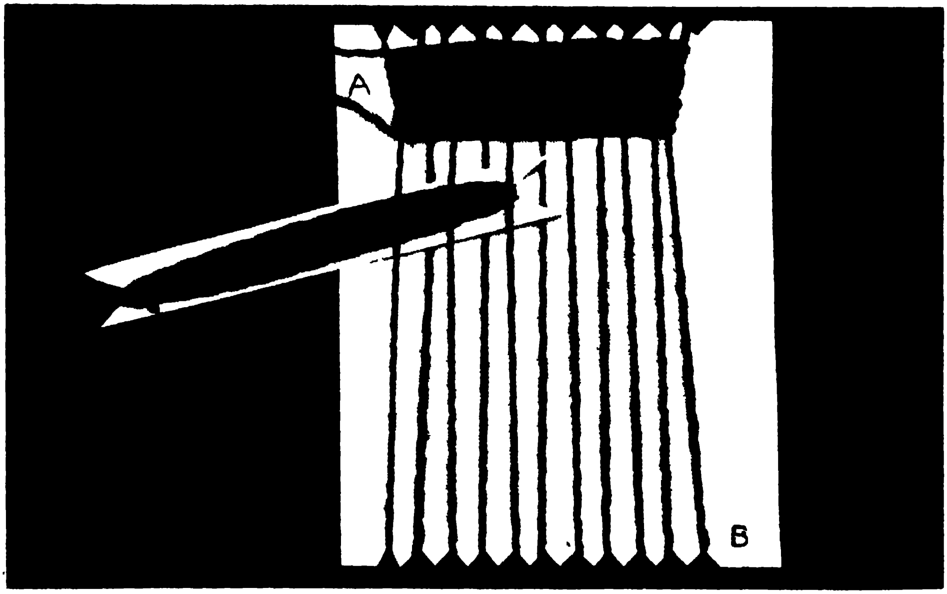


FIG. 2

In Fig. 2 can be seen a loom and shuttle which any child could make in cardboard. On it can be woven dolls' carpets in wool, mats in raffia, tea cosies in wool, and other useful things. When the process of weaving has been mastered, the child will probably feel a desire to make a larger loom in wood on which more ambitious articles embodying interesting designs can be woven.

To Thread the Shuttle

Take the other colour of wool.

Secure the end of it in the small slit on the shuttle, and wind as much on to the shuttle as it will hold.

Tie the free end from the shuttle to the piece of wool left at the back of the loom. Now start weaving by passing the shuttle under and over the warp threads as in darning (Fig. 2). Care must be taken not to pull in the end threads of the warp. If this cannot be avoided put a knitting needle down each side and weave it in with the end thread. It can easily be pulled out when the weaving is finished. Continue until the warp is all covered.

The weaving threads that go across are called the weft, or the woof, and the whole fabric is called the web.

Untie the wool at the back and slip the web off the loom. Darn in the short end of weft thread at each end and fill in the loops at the ends either by darning with the long ends of warp wool, or, if a rug is being made, with a fringe.

If a fringe is to be used, cut a number of pieces of wool 3 inches long. Double one piece. Put the looped end through a loop in the rug and pull the two loose ends through the loop (as string is put in a luggage label). Knot one 3-inch piece of wool into each loop.

The web can be woven in patterns by going over or under more than one warp thread, or by using another colour of wool to weave stripes. If the tacking stitch borders have been done it will be found that the patterns in those can nearly all be worked in weaving.

Many things besides dolls' rugs can be woven, such as egg cosies (on a smaller loom), mats or pochettes. Raffia, twine and silk can all be used. Wool woven on a twine or silk wrap gives good results.

Age 7 Years

INDIAN BASKETRY

Materials :—

Raffia.
Raffia Needles.

Method

Take three strands of raffia by one end. Make a loop round the first finger of the left hand with these and tie the strands together, where they cross, with a fourth strand (Fig. 1). Pull the ends until the loop almost closes up. Thread the fourth strand of raffia on to a needle and take four tight over-sewing stitches into the loop. Pull the ends again so that the loop quite closes (Fig. 2).

The long ends from the loop are called the tail. The strand with the needle is called the working thread.

After the loop is closed, take the tail in the left hand and the working thread in the right. Wind the working thread once round the tail, towards the body, then take it over the top and forward again and pass the needle through the centre of the loop. Repeat thus until six stitches have been taken into the centre and the work has again reached the knot.

Now cut the short threads off close to the knot and continue as before, once round the tail, but, instead of inserting the needle into the centre, put it into the space left by the twist round the tail on the first round.

It will be necessary to increase a stitch or two on each round on the base of the basket. This is done by taking two stitches into the same space, winding the thread once round the tail between these two stitches. The extra stitches should be spaced at equal distances on the round.

Add another strand of raffia to the tail once in every round until there are eight strands (If a very large basket or a tray is being made, add strands until the tail is of the desired thickness) When one strand in the tail is finished a new one must be added, as the tail must be kept at a uniform thickness

FIG 1
This shows the first step in making the base of a coiled Indian basket in raffia It is of importance that this step should be learned thoroughly, as all round baskets are begun in the same way, whatever stitch may be used later, and no basket can be successful without a satisfactory centre

FIG 2

In Fig 2 four stitches have been taken into the loop seen on the finger in Fig. 1 and the ends are being pulled to close the loop

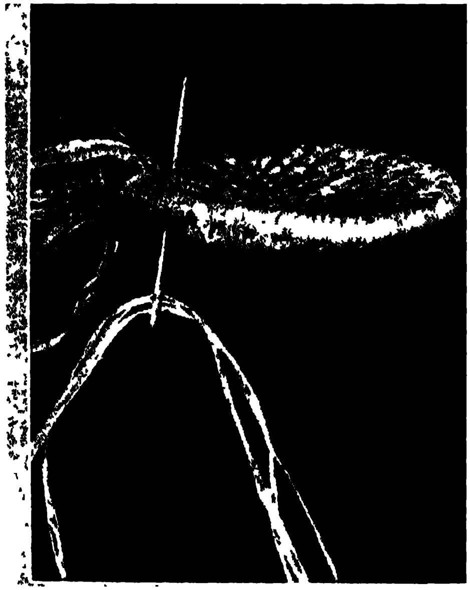


FIG 3

This shows how the tail is placed when the sides are to be raised The tail should be pulled rather tightly while the first round is being worked

When the working thread is nearly finished, let it be added to the tail and take a new thread. Hold the end of this, with the tail in the left hand, close to the basket and wind it round the tail in the ordinary way.

When the base is sufficiently large, start the sides by laying the tail on top of the last round instead of outside it (Fig. 3).

Continue without adding any stitches until the sides are of the height desired.

On the last round taper the tail by cutting off the strands at intervals until there is only one left. Fasten this down securely and run the working thread back inside the last round for about an inch, and cut both it and the tail strand off so that they do not show.

This method is known as LAZY SQUAW stitch, and is illustrated in Fig. 6.

Another method, which is known as coiled Indian stitch, is illustrated in Fig. 4. In this the working thread is brought forward over the tail and a stitch is then taken through from the back. Now pass the working thread up over the last sewn-down coil, behind and over the tail, and through from the back again. The centre is the same whatever method be used.

One of these two methods should always be employed for the base of the basket, as they are very strong and firm.

Two varieties which may be used for mats, or for the sides of baskets, may be seen in Fig. 5. The light part here is done in coiled Indian stitch, with four twists round the tail between the stitches. The border is done in Lazy Squaw stitch with four twists instead of one round the tail between the stitches.

In working coloured borders like those in Figs. 6 and 7, a coloured strand is introduced into the tail and this is used instead of the working thread for the coloured stitches, the working

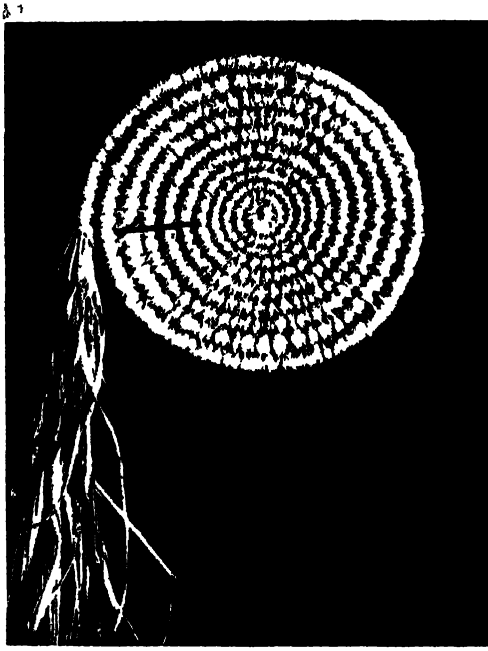


FIG 4 shows a base in coiled Indian stitch, which is perhaps the favourite stitch of most people The working thread is wound about the tail and brought through the last-completed round This makes a firm base

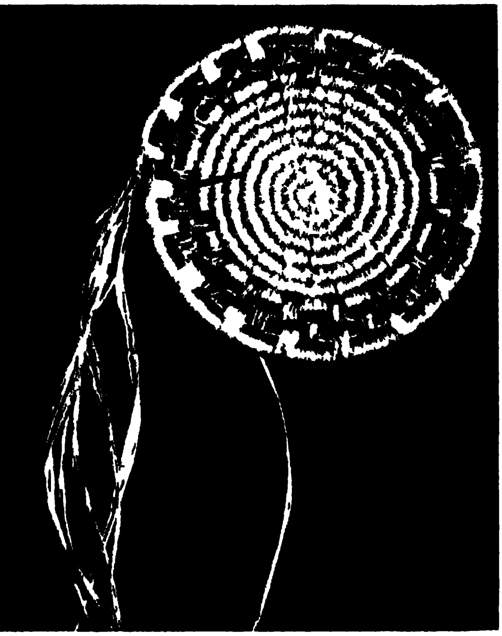


FIG 5 — The light part has been worked in coiled Indian stitch with the thread wrapped four times round the tail and the border is in Lazy Squaw with the thread wrapped four times round the tail

FIG 6 shows a basket done in Lazy Squaw stitch, with a coloured border introduced In this stitch the coloured part shows clearly, as the long stitches stand out from the others

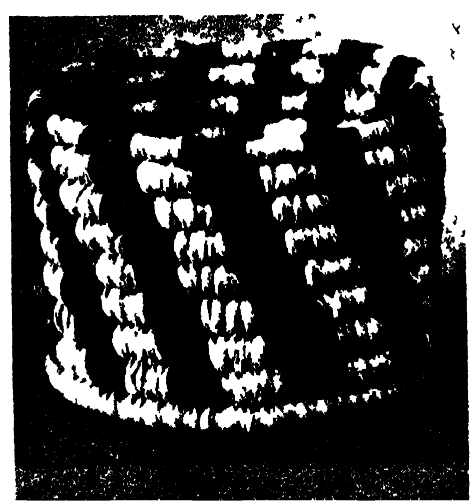


FIG 7 Care must be taken to make the spacing even in working a basket of this kind The stitches on the last row should be counted and the design worked out on squared paper before the side is started.

thread taking its place meanwhile in the tail.

Very interesting designs can be worked out in one or more colours. Ideas for these can be obtained by studying Indian baskets in museums. The Indians dye the materials for these with the bark and roots of various trees, and such natural dyes give the best colours. Boiling raffia with onion skins, old tea leaves, or coffee grounds, and rinsing well afterwards, will give good colours. Walnu... will give green in summer and brown in autumn. Lichens may be gathered on country walks and used to dye raffia. Some give green and some give a lovely yellow. Logwood, used alone, or with alum, with iron or with ammonia, produces excellent colours. Oxblood and cudbear are also useful. These can be had from the chemist, but it is more interesting to find one's own dyeing materials in the woods.

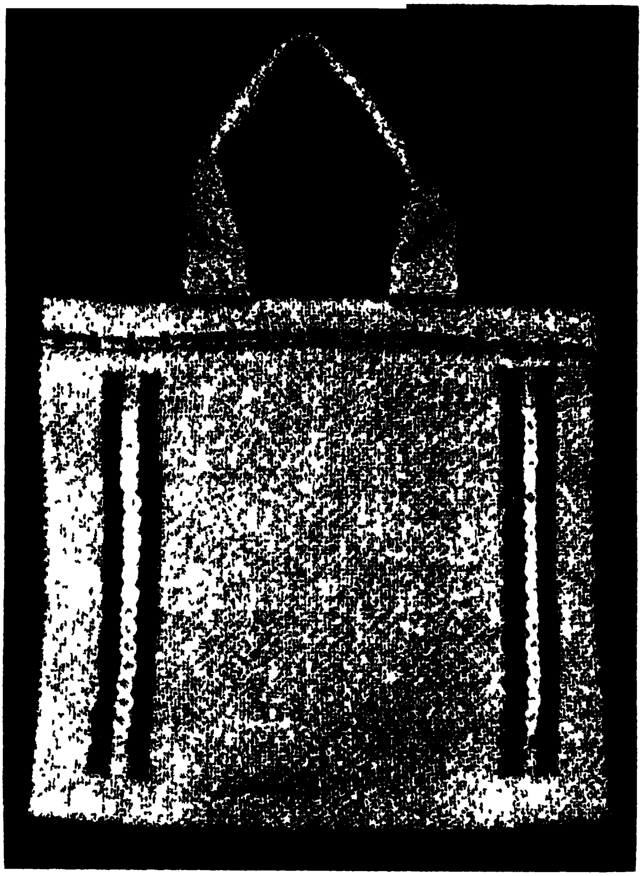


FIG. 8

This is the completed shopping bag described on this and the next page. Strong material that is not too stiff for the passage of the needle should be used—hessian is a good choice

The Indians of North America make a great many of their household possessions in this basketry. They make cradles, trays and quite large chests with lids; and some of their bask...s are so finely woven that they will hold water.

SEWING

Cross-stitch and over-sewing can be done now that tacking stitch has been learned. A shopping bag is a good article to make.

Materials :—

¾ yard Crash, 12 inches wide, with selvedge at both sides.

A piece of Wide-meshed Canvas.

Coloured Wools.

Crewel Needle.

Method

Cut two strips of crash, each 3 inches wide, across the width of the material. Turn a ½-inch hem to the same side on both edges of each piece. Now fold each strip lengthwise with the raw edges turned in, and tack.

Turn a double hem of 1 inch at each end of the other piece of crash. Tack these down to the right side and sew them on the right side, using coloured wool and any tacking stitches desired.

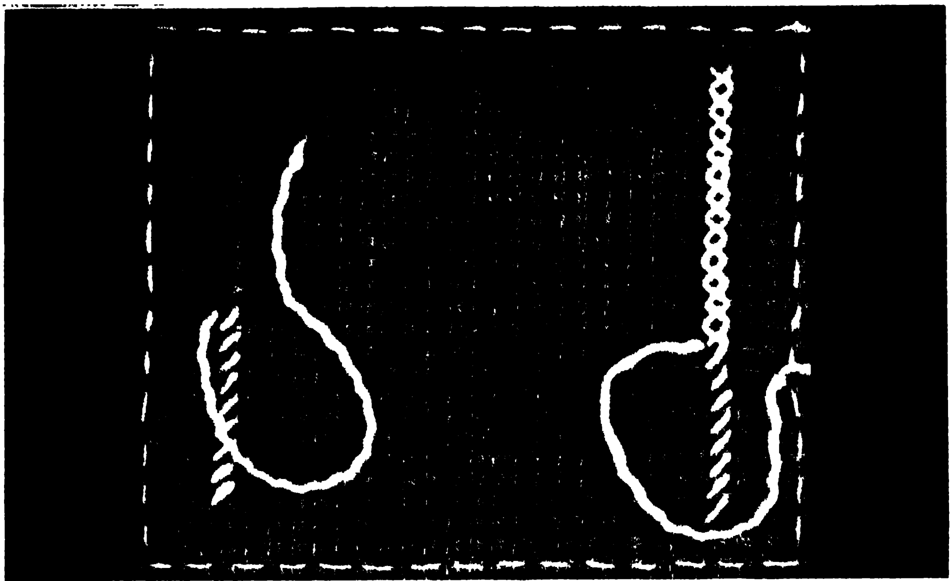


FIG. 9

Here you see the first row of stitches in position. It is most important that all the stitches should slant in the same direction. This applies to all cross-stitch work.

FIG. 10

Above the covering stitches are seen. This illustration shows also how the canvas is tacked on the front part of the bag before the work is begun. It must be firm and quite flat.

Fold the large piece of crash in two, with the sewn hems together.

Now take a piece of canvas the size of the folded bag. Tack it firmly to one-half of the bag on the right side.

In working cross-stitch, bring the needle through from the back in a square near the lower left-hand corner of the canvas, working through both canvas and crash, which is now opened up flat. Count one square up and one to the right and put the needle in again here. Bring it out in the square to the left of the one where it was inserted, count one square up and one to the right, put the needle in, and bring it out at the next square on the left. Continue this until the hem is reached (Fig. 9). All the stitches must slant from right to left.

Now work down from the top and cover all the stitches already made with others slanting in the opposite direction, *i.e.*, from left to right (Fig. 10).

Another row can now be worked in the next spaces on the right, using another colour of wool. Begin two squares up from the end of the first row and stop two squares from the top. A third row in the first colour and the same length as the first row should now be worked on the right of the second row (Fig. 8).

The pattern is next worked at the right-hand side of the bag, and then the threads of the canvas are all pulled out, leaving only the sewing on the crash (Fig. 8).

Tack and over-sew the sides of the bag (for over-sewing, see Plain Needlework section) in one of the colours already used. Over-sew the two strips and sew them securely to the two sides of the bag as in Fig. 8.

Cross-stitch can also be done on loosely woven material, where the threads of the material can be counted and act as a guide. Initials on linen are often marked in this way.

Cross-stitch is used in working tapestry. In this the design is stamped on the canvas or it can be copied stitch by stitch from a chart. The background is filled in afterwards.

Long ago women were fond of commemorating events in this way. They were not taught to draw or paint and this was their only means of pictorial expression. Queen Matilda worked a tapestry representing fifty-eight scenes in the life of her husband William the Conqueror. Mary Queen of Scots and her Maries worked many tapestries of this sort. They were used as wall hangings and may be seen in historical buildings to this day.

Age 8 Years

CANE BASKET WEAVING

Pulp cane is the most suitable material for beginners to use, as long lengths of uniform thickness may be obtained.

For a first basket a very simple shape should be made, so that the whole thing can be done without help.

Materials :—

Pulp Cane No. 6 and No. 3.
A pair of Scissors with rounded ends.

Method

Soak the cane for one hour. Cut eight stakes 20 inches long in No. 6 cane.

Lay four of these on the table from left to right and the other four on top of them to form a cross, with all arms of the cross the same length. Cut another stake 12 inches long and put it with the stakes at the left hand arm of the cross, with the ends level. Now turn the cross so that the five stakes are at the top.

Take a piece of No. 3 cane. This is called a weaver. Lay the end of it on top and across the four stakes that go from right to left. Weave it under the five at the top, from the left, over the four at the right, under the four at the bottom and over the four at the left. In the second round take it under the odd stake (Fig. 1), over the other four at the top, under the four at the right side, over the four at the bottom and under the four at the left side. Third round, over the odd stake and so on until the weaver comes back to the odd stake again ; weaving is always done from left to right.

Pull the stakes away from each other in twos and weave under and over these for three rounds. Now pull them away from each other again so that they are all separate. Be sure that the space between them is the same width.

When the base measures 6 inches across put it to soak again and cut seventeen stakes of No. 6 cane 10 inches long. Soak these also.

Insert one of these stakes at the right side of each of the base stakes, pushing it into the base weaving as far as it will go.

Gently bend all the stakes at right angles to the base, taking care not to crack the canes. Tie all the ends together with string at the top and leave for half an hour.

There is still a weaver attached to the base. Add another weaver by putting it between the two pairs of stakes in front of the weaver already there.

Bring the back weaver over one pair of stakes, behind the next pair and out to the front. Leave it there. Take the other weaver. Bring it over one pair of stakes, behind the next pair and out to the front. This is called pairing (Fig. 2), because it is done with a pair of weavers.

Do three rounds of pairing, then, using the two weavers as though they were one, and keeping the stakes still in pairs, weave nine rounds over one and under one. Working with two or more weavers in this way is called slewing.

Still using the same pair of weavers, do three more rows of pairing and cut both the weavers off inside.

Soak the basket upside down for half an hour.

Take any pair of stakes, and, weaving to the right, pass it behind one pair, in front of the next, behind the third and leave it inside. Do this until all the stakes are woven in, weaving the last pairs so that no join shows.

Cut the ends off close inside.

Fig. 3 shows this basket completed.

TO MAKE A STRONGER BASKET

Materials :—

No. 12 Cane.
No. 8 Cane.
No. 4 Cane.
A Knife and a Bodkin.

Method

Cut eight base stakes, 7 inches long, in No. 12 cane. Make a split 1 inch long in the middle of each of four of these, using the bodkin (Fig. 4).

Take one of the unsplit stakes and pass it through the cut in each of the four split canes. Put the other three in the remaining space, making a cross.

Take a long length of well-soaked No. 4 cane and bend it, not quite half-way along its length. Hold the base stakes between the thumb and fingers of the left hand, with the split canes pointing up and down. Put the loop in the No. 4 cane over the top arm of the cross, twist the ends once (Fig. 5) and work two rows of pairing.

Open the stakes up into twos and work two more rows of pairing, then open the stakes again so that all are separate and work another two rows in pairing.

Cane weaving is a craft in which great accuracy and attention to detail are necessary. Each stake should point in its proper direction from the start, and care must be taken to maintain that direction throughout.

In weaving, the fingers of the left hand should always be inserted between the stakes, holding the weaver that has just been placed by the right hand. When a new weaver is needed it should be crossed above the end of the old weaver behind a stake, on the inside. It is only by giving great care to such details as these that good, even work can be produced.

The rest of the base is to be done in randing. Randing consists in taking the weaver over one stake and under the next. As the number of stakes in this basket is even, two weavers must be used. These follow each other round, but do not cross as in pairing.

Take the two weavers already in use. Take the one which finished the last row of pairing all round, over one and under one, until the second weaver is reached. Now take the second weaver all round, over one and under one, stopping just short of the first weaver. Continue this until the base measures 6 inches across. The last row must be done in pairing. Cut the weavers off and cross them.

Cut the base-stakes close to the weaving.

Cut thirty-two side-stakes each 14 inches long, in No. 8 cane. These must be slyped, as in Fig. 6, and then the cut ends put to soak for half an hour.

With the bodkin make a little passage at both sides of each base-stake in turn, inserting the slyped end of the side-stake as soon as the bodkin is withdrawn. Gently bend the side-stakes until they are at right angles to the base. Tie them up and leave them for half an hour.

Upsetting the sides is done with three rows of triple weaving (sometimes called three-rod waling). The principle is the same as in pairing, but three weavers are used.

Insert three well-soaked No. 4 canes. Take the one on the left in front of two stakes, behind one, and out to the front. Always using the cane on the left, continue to do this until the three rounds are completed, taking great care that the stakes are equidistant and that each points in its proper direction.

Work the sides in randing, using two weavers. The basket in Fig. 7 has five rows of three-rod waling to strengthen

CANE BASKET WEAVING (1)

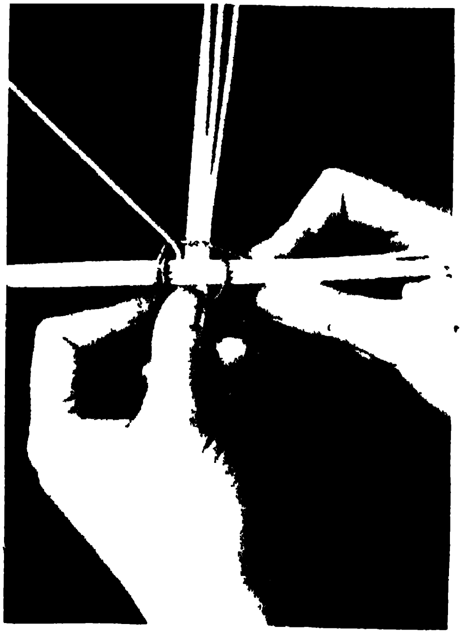


FIG. 1 shows the beginning of a basket in cane weaving. Note the position of the odd stake. It remains separate from the rest until the base of the basket is finished.

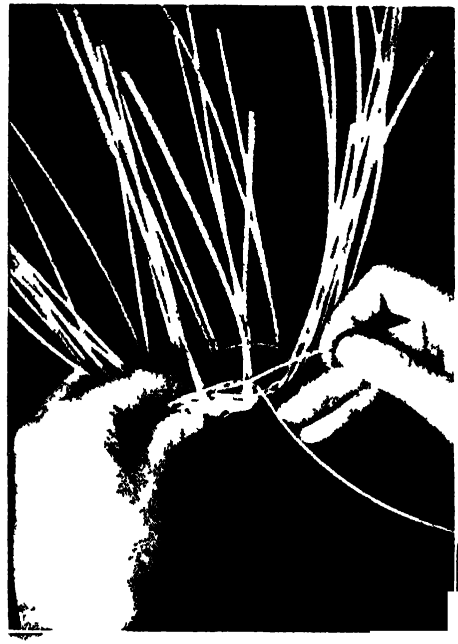


FIG. 2 shows the upsetting of the sides after the side stakes have been inserted. The weave shown is called pairing. It is stronger than single weaving.

FIG. 3.—The finished basket. It would make a good waste paper basket. A work-basket could be made in the same way with a wider base and shorter sides.

FIG. 4.—The canes are being split to start a strong base. The split must be exactly in the middle of the cane and just long enough to take the other four canes.

CANE BASKET WEAVING (2)

FIG. 5 shows how the weaver is started in pairing. The loop must be not quite in the middle of the weaver, so that when the new weavers are joined on they come at different places.

FIG. 6.--Here the method of slyping cane is shown. Make a gradual cut, leaving half the thickness of the cane at the end. Cane is slyped before being inserted for stakes or handles.

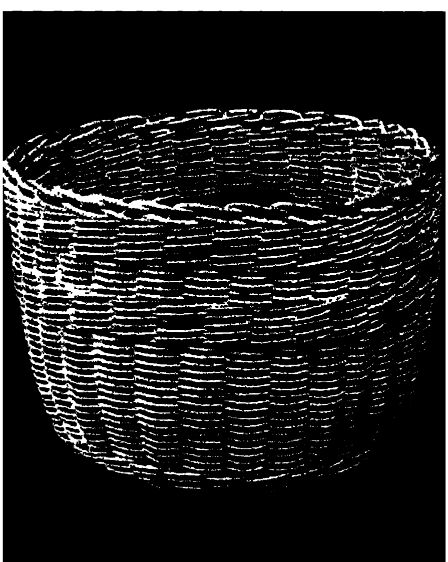


FIG. 7.--The upsetting of the side of this basket is done in three-rod waling. There is a strengthening band of this before the border is reached. The rest is done in randing.

FIG. 8.—Note how the handle is inserted and bound down with the split cane. The piece that made the cross is bound in all the way across, so that the handle cannot be pulled out.

it, then four rows of randing, before the final five rows of three-rod waling which make a firm foundation for the border.

The border is worked, after the canes have been soaked for half an hour, by bending any cane in front of the one to the right, behind the second, in front of the third, and behind the fourth, where it is left. The first two or three stakes to be bent for the border must not be pressed too close to the side, as the last stakes have to be woven under them. All the rest must be pressed down as closely as possible.

To Insert a Handle

A basket which is to be given a handle should have an even number of side stakes. Cut one very thick cane (or two thinner ones) to the length of the handle, plus twice the measurement of the side of the basket. Thus, if a 17-inch handle is wanted on a basket having sides 5 inches in depth, a cane 27 inches long must be cut (in Fig. 8 two lengths of No. 12 used).

The two ends must be slyped and pushed down beside two side-stakes on opposite sides of the basket, until they reach the base.

Call the two points where the handle enters the sides A and B respectively.

Take a piece of well-soaked split cane. Insert one end of it (at A) from the front, under the waling, and to the right of the handle-stake. Leave 10 inches on the inside. Take the other end of the split cane, carry it across the waling and the handle-stake and insert it under the border. Bring it to the front again under the waling, but still on the left of the handle. Cross to the other side of the handle and insert it under the border on the right side.

Now carry this long piece over the handle to B and bind the handle down on that side in the same way. When this is done, continue with the same cane (which must be sufficiently long to reach the other side) and wrap it firmly round the handle and the piece of split cane until A is reached (Fig. 8).

Push the end of the wrapping cane well down the side of the basket and fasten it down with the first end, which must then be pushed down the side also, behind the handle.

SEWING

Blanket stitch and Daisy stitch can now be learned.

A pram or cot cover would be a good article to make. Tea cosies or hot-water bottle covers would also be suitable.

Materials :—

A piece of soft Woollen Material 36 inches by 20 inches.
Coloured Wools.
Crewel Needles.

Method

Turn a single ½-inch hem all round to the wrong side and tack.

Choose a thick wool in a colour to harmonise with that of the material. Hide the starting knot under the hem and work all round in blanket stitch. This is done by holding the thread down with the left hand and lifting a stitch, with the needle pointing downwards. Put the needle through (Fig. 9). Work the corner as shown.

Ornament the cover with daisy stitch (see Embroidery Stitches), using one colour for the flowers and green for the leaves, making a suitable design.

KNITTING

The easiest way to learn to knit is to study the pictures, which show each step as it is done.

Some things which it is useful to know cannot be shown in pictures, but they are very important and, as knitting is one of the most useful crafts known, they should be carefully noted from the start.

Keep the work clean when not being done by wrapping it in a cloth, as wool catches dust very easily.

Always join wool by darning one end into another for about 2 inches.

When knitting a plain row, slip the first stitch purlwise.

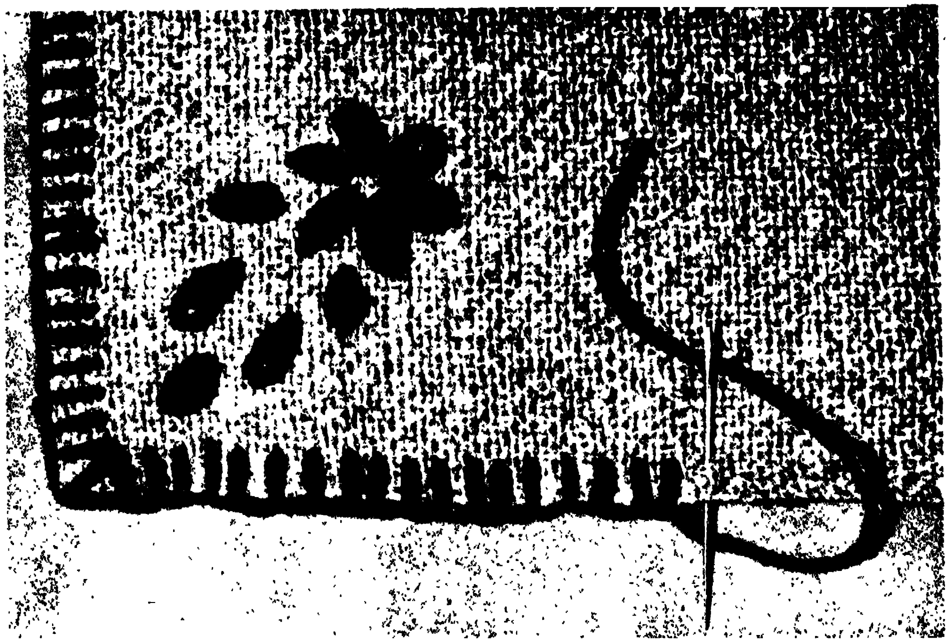


FIG. 9

Blanket stitch in thick wool is worked all round the pram cover shown above. The decoration is in daisy stitch. When plain blanket stitch has been learned, it is interesting to work alternate long and short stitches, but many different arrangements may be made.

When knitting a purl row, slip the first stitch plainwise. These make neat edges.

If the knitting seems too loose, use smaller pins. This will produce more even knitting.

If the casting off is too loose, use a smaller pin than that used for the rest of the work.

A cover for a doll's bed is suggested as a start. With 5-ply wool and No. 6 pins cast on fifty stitches. Work as long as desired in garter stitch and cast off.

Fig. 1, To Cast On

Hold the wool between the second and third fingers of the left hand, leaving 2 yards of wool at the back of the hand for every 100 stitches to be cast on. Twist the wool round the left thumb. Put the needle into this and knit it with the long end of wool attached to the ball, as if it were a stitch. Make another loop with the other end of wool and knit it in the same way. Cast on as many stitches as desired. This makes a very firm edge which will not stretch.

Fig. 2, Garter Stitch

In this stitch every row is a plain row, and is knitted by putting the needle into the stitch from the left side of the stitch, bringing the wool from the back and putting it between the needles, pulling the wool through with the right-hand needle and then slipping the stitch off the left-hand needle. There are four movements in each stitch, in, over, out and off.

Fig. 3, Stocking Stitch

(Alternate rows of plain and purl.)

The right side of stocking stitch is knitted in the same way as garter stitch.

FIG. 1 shows how to cast on stitches for knitting. There are several different methods for this, but the one illustrated above is most generally useful as it gives a good firm edge. Care must be taken to leave sufficient wool in the left hand to cast on the required number of stitches. The casting on of stitches for garments must not be too tight or the strain will break the wool.

FIG. 2.—Here the method of working garter stitch is seen. The position of the hands is important. It will be noted that the wool is twisted round the middle finger of the right hand. This regulates the tension and keeps the work from becoming too loose. This is a useful stitch for pram or cot covers, babies' clothes, jumpers and many other things. Both sides are alike.

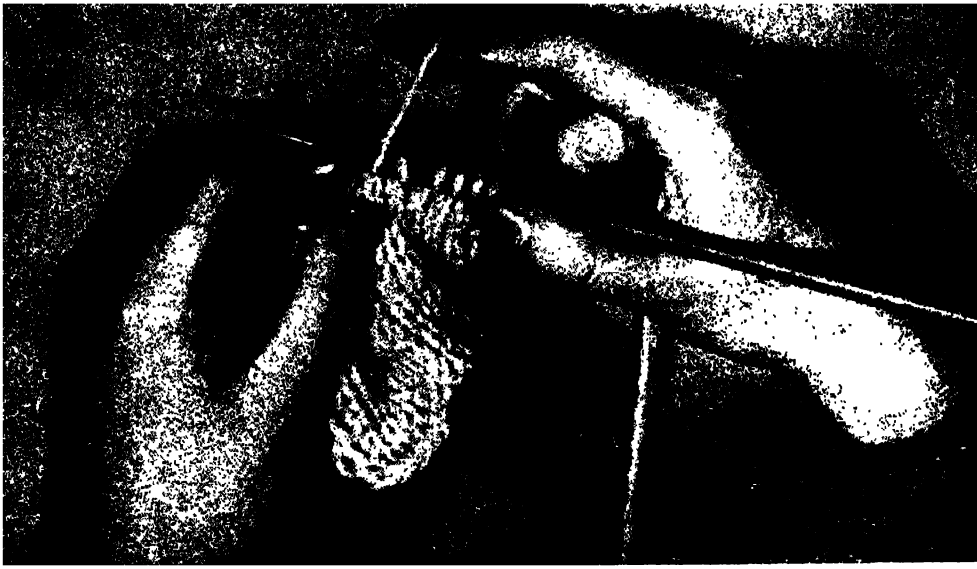


FIG. 3.—This shows the plain side of stocking stitch. This stitch is used for articles that are to be seen only on one side. For jumpers, dresses, hot-water bottle covers, caps, etc., it is useful. It gives a lighter web and stretches more easily than garter stitch and it takes less wool to work than the other. The finished surface is smooth instead of ribbed.

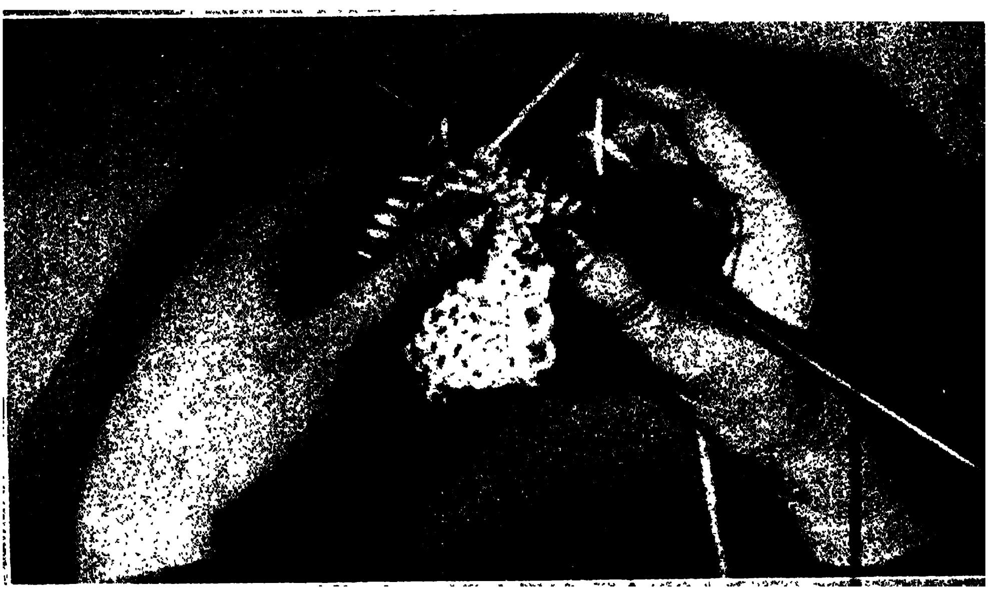


FIG. 4.—When stocking stitch is done on two needles only the reverse side must be purled. As will be seen above, the needle is put into the front of the stitch from the right and the wool brought forward over it. In making socks and stockings the work is done on four needles continuously, so that it is all done from the front, and there is no purl row. The wrong side looks like garter stitch.

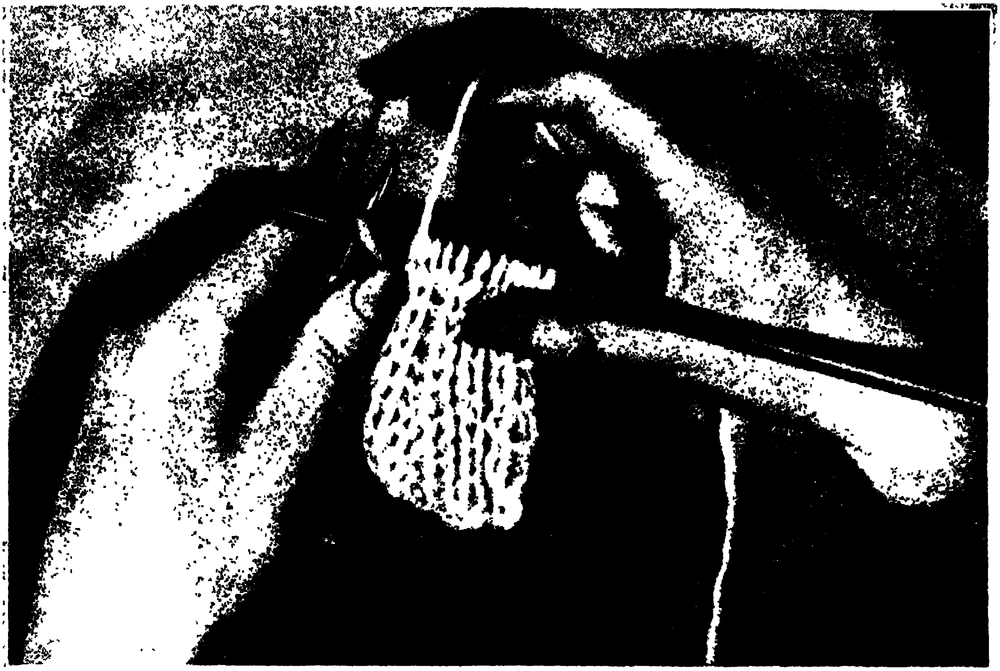


FIG. 5.—Ribbing is used when an elastic web is required. It is done by working a certain number of stitches plain and a certain number purl. On the other side the order of purl and plain is reversed.

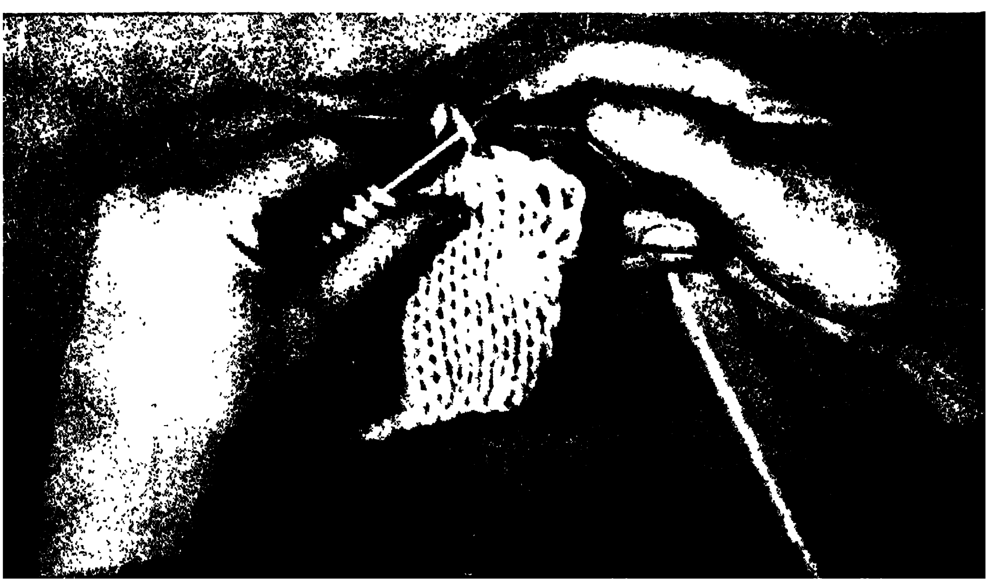


FIG. 6.—Here the work is being cast off. Two stitches are knitted, and the first lifted over the second and slipped off the needle. Care must be taken not to make the casting off too tight.

Fig. 4

This shows the wrong side of stocking stitch. Put the needle into the right of the stitch from the back, put the wool between the needles, pull it through and slip the stitch off.

Fig. 5, Ribbing

This is done by knitting so many stitches plain and so many purl. Any number may be used, but the smaller the rib the tighter the web. Two and two is useful. Knit two stitches plain, bring the wool forward from the back to the front, purl two stitches, take the wool through from the front to the back. Repeat to the end of the row. In knitting a two and two rib the number of stitches must be divisible by four. In knitting three and three rib the number must be divisible by six, and so on.

Fig. 6, Casting Off

Knit two stitches. Insert the left-hand needle at the left-hand side of the first knitted stitch and slip it over the second knitted stitch and off the needle. Knit another stitch. Lift the second knitted stitch over the third and so on to the end of the row. When only one stitch is left, break off about 4 inches of wool, draw it through the last stitch and pull it up, then darn the end up the side of the knitting where it will not show.

CROCHET

Crochet also can best be learned from pictures. Use a bone crochet hook for wool or thick silk and a steel one for cotton or thin silk.

Fig. 6 shows a scarf that could be made by a beginner.

With a No. 8 bone crochet hook make a chain, with 5-ply wool, 1 yard long. Work a row of double crochet all round on both sides of this, back to the starting point.

Now work a row of treble crochet all round the double crochet, working only into the backs of the loops.

Continue this, using two or more colours and either double or treble crochet, until the scarf is the desired width, then break off 4 inches of wool, pull it through the last loop and darn it in.

Shawls, tea-cosies, chair-backs, caps and many other things can be made in crochet.

Fig. 1

Chain, which is the beginning of all crochet. Make a loop in the end of the wool. Pull the wool through this loop. Continue to pull the wool through each loop until the chain is sufficiently long.

Fig. 2

Single Crochet consists in putting the hook into a stitch in the chain or into the back loop of another stitch, putting the wool over the hook and pulling it through both loops at once. (Pull through once.)

FIG. 1

This shows the method of making chain, which is the beginning of all crochet. Chain may also be used as a draw-string for knitted or crochet garments.

CROCHET

FIG. 2.—In single crochet, which is shown above, the wool is pulled through the loop only once, as the name implies. This stitch is used to neaten edges, as the work is very firm and close.

FIG. 3. —Double crochet, in which the wool is pulled twice through the loop, gives a very firm unyielding fabric. For yokes and cuffs of dresses and jumpers it is most suitable. It also may be used to neaten edges.

FIG. 4.—In treble crochet the wool is pu three times through the loop. This gives a long, cord-like stitch. In wool it makes a light and fleecy texture, but it is mostly used in making fancy borders for trimming household linens, in cotton.

.. the wool is pulled four times through the loop. This gives an even lacier texture than treble crochet, in wool. The stitch is useful in making slots through which ribbon is to be threaded.

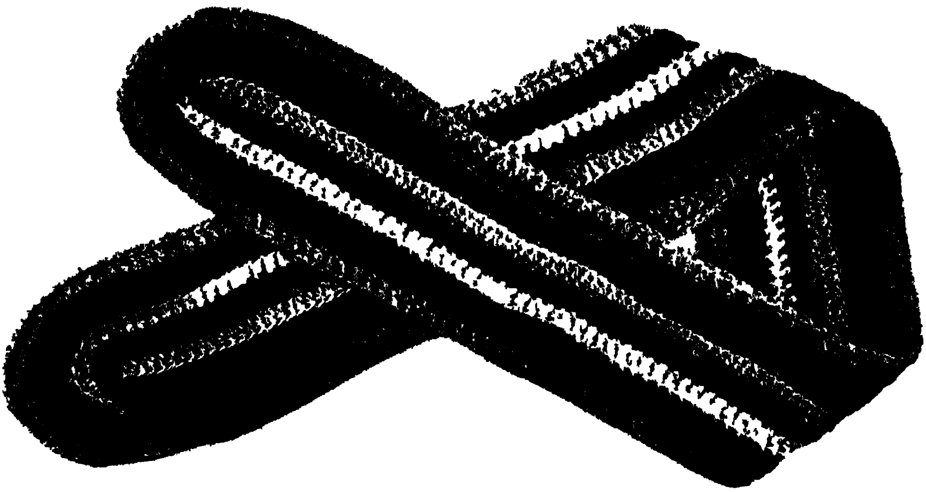


FIG. 6

The scarf above could be made by quite a small child. Very many useful things may be made in crochet in wool, and it is a craft which children much enjoy. They must be allowed free choice of wools and must also be permitted to determine the shape of the article themselves as otherwise this craft gives little scope for the creative instinct.

Fig. 3

Double Crochet starts in the same way as single crochet, but instead of the wool being pulled through two loops it is pulled through one, then the wool is put over the hook again and pulled through the remaining loops. (Pull through twice.)

Fig. 4

Treble Crochet. In this stitch the wool is put over before the hook is inserted. It is then pulled through one loop, the wool put over again and pulled through two loops, the wool put over a third time and pulled through the last two loops. (Pull through three times.)

Fig. 5

Double Treble Crochet. In working this the wool is put over the hook twice. The hook is then inserted and pulled through one loop, the wool is put over and pulled through two loops, the wool is put over a third time and pulled through two loops, and then it is put over a fourth time and pulled through the remaining two loops. (Pull through four times.)

POTTERY

Nowadays potters shape the clay on a potter's wheel. Long ago, before people lived in houses, they had nothing of that sort to use and had to make their pots by hand. The method they used was very much the same as that employed by the North American Indians to make baskets, and the only tools they had were their own hands and pieces of stone, stick or bone.

Take some clay just damp enough to be workable. Throw it down very hard on a table, pick it up and throw it down again. Do this a great many times. It is to drive all the air bubbles out of the clay and to distribute the moisture

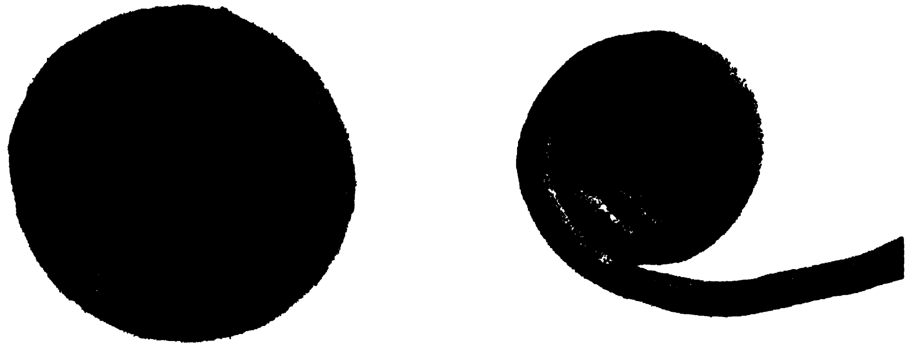


Fig 1 At the bottom of this illustration can be seen the beginning of the coil with its tapering end On the right the coil has been smoothed out in the centre Each round must be smoothed as completed On the left the completed base is seen smoothed on both sides trimmed to an exact round and ready for the first coil forming the side to be added

Fig 2 shows the raising of the sides on the base Note that each coil is joined at a different point The position of the hands whilst smoothing the sides is very important The thumb of the one hand should always be inside the pot to keep the clay from being pressed out of shape while the forefinger of the other hand smooths the outside, and *vice versâ*

This shows a pot made entirely by hand in coiled pottery with the decoration put on with a piece of stick. The smoothing of the sides must be done with a very gentle movement so that the pressure does not make the clay thinner in some parts than in others.

evenly. Cut it through with a wire and see that the clay is tightly packed together and stick the two pieces together again. Cover with a damp cloth. Repeat this every day for two or three days. It is called wedging the clay.

The clay should now be in a fit condition for use. Make a long roll of clay, slightly thicker than the pot is to be, by rolling the clay with the hand on a table or board. The end should taper to a point. When a long roll with no breaks has been made, start coiling it round as in the coiled basket work, pressing the coils close together and smoothing out the grooves with the thumb (Fig. 1).

When the base is large enough and quite flat, turn it over and smooth the other side. See that it is quite round. Lay the next coil on top of the edge instead of alongside and break off the coil when the round is completed. Start each coil in a different place, so that the joins do not come above each other (Fig. 2). The pot must now be smoothed outside and inside as the work is done. Continue until the pot is the right size.

A pattern can be made with a small piece of stick on the outside, taking great care not to press heavily or the pot will be thrown out of shape (Fig. 3).

The pot must be left alone for several days to dry.

The old way of firing pottery was to make a wood fire, then to rake it out, put the pot in the middle, and cover it with the hot ashes, leaving it there until it was cold. This can be tried, or the pot can be fired in a kiln in a pottery.

The use of the wedging will now be seen, for, if any water or air was left in it, the clay would sink in the firing at that place and the pot would be warped.

If the pot is to hold water it must be glazed and fired again. This second firing must be done at a pottery, as the heat to fire glaze must be much greater than any that can be maintained elsewhere.

Visits to museums, where primitive pottery may be studied, will yield ideas for shapes and decoration.

SEWING

Some of the plain needlework stitches should now be learned. Using these (see Plain Needlework section) and tacking or other embroidery stitches make the apron illustrated in Fig. 4, p. 406.

Materials :—

1 yard Linen or Casement Cloth of a neutral shade.
Sewing Cotton.
Thick Embroidery Cottons in several colours.
Sewing Needles and Embroidery Needles.
Ruler.
Thimble.
One Button.

Method

Cut a 5-inch strip across the width of the material.

Taking the large piece of material, turn a ½-inch hem down each side, then fold over again, making a hem 1 inch wide. Tack both sides with sewing cotton.

Turn up ½ inch along the bottom and fold over again to make a hem 4 inches wide. Tack with sewing cotton. All these hems are to be turned to the right side.

Choose which colours of embroidery cotton are to be used and work a simple border on both hems, on the right side of the material.

Measure 4 inches up from the bottom hem. A crease may be made as a guide for the first row of tacking stitches, but no other guides may be used in working this border as the eye must be trained to judge the spacing without a guide.

Any tacking or embroidery stitches may be used in this border. Chain stitch is very effective used with tacking stitch. Blanket stitch, couching and herring-bone stitch also are good. Several colours may be used. The design must balance, *i.e.*, the top and bottom lines should be the same. The lines inside those should correspond, and so on into the middle line (see Fig. 5).

Study embroideries in museums done by Russian, Rumanian, Czecho-Slovakian and other peasants. Their colour groupings are always good and many ideas may be obtained.

The top of the apron may be pleated as in the illustration, or it may be gathered and set into the band (instructions for setting gathers into a band are given in Plain Needlework).

The ends of the band which come beyond the apron on both sides should be over-sewn in colour and finished with a button and a loop to fasten.

PLAIN NEEDLEWORK

There are certain seams and stitches that are used on all garments and household linens. These are described and illustrated here. It is important that the correct way of doing each stitch and seam should be learned at the beginning, and these few general directions carefully noted.

The working materials ought to be chosen with care so that the results may be good.

Use as fine a needle as is suitable for the material. Its point should be very sharp (except when a tapestry needle is used) and its eye just large enough to take the cotton or silk. A blunt point or a large eye would pucker the material.

For plain needlework use as fine a cotton or silk as is suitable for the material.

Knots should never be used, except to start tacking or gathering. All other seams should be begun by taking several small stitches backwards. These will be covered by the seam. In hemming they should be hidden under the hem. This applies also in joining thread.

Take only a short length of cotton or silk in the needle. A large one twists and becomes knotted.

Use a thimble with no jagged places to catch threads.

AN EMBROIDERED APRON

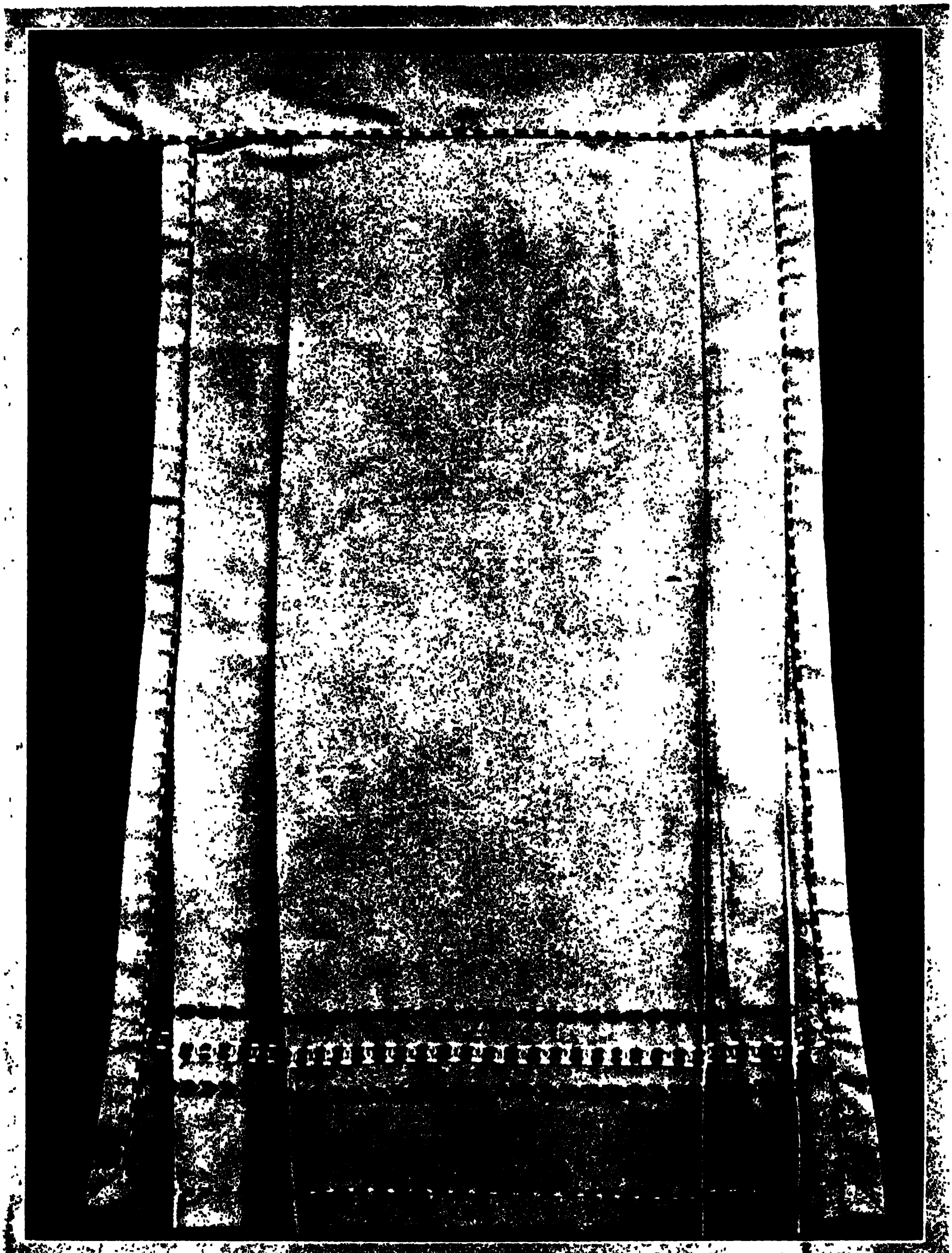


FIG. 4.—Now that the child has gained more control over the muscles, a smaller needle may be used, and finer sewing learned. The first article should be simple. An apron is a good choice, as the seams are short and the decoration keeps the work from becoming monotonous. Choice of materials should be left entirely to the child. If the choice later be found to be unsuitable more will be learned from the mistake than from advice.

Sit with the light coming over the left shoulder. Keep the back straight and hold the seam as near the eyes as is necessary. Never bend the head down to the seam.

The stitches and the spacing are large in the illustrations, so that the method of working may easily be seen.

Tacking (Fig. 1)

This is used to keep two pieces of material in place while they are being sewn together. Take small stitches through, with a long stitch between, near, but not over the place to be sewn. It is best to tack with cotton or silk of a different colour from the material as it shows up better and can be more easily removed. The tacking should be even, as it acts as a guide for the sewing.

Hemming (Fig. 2)

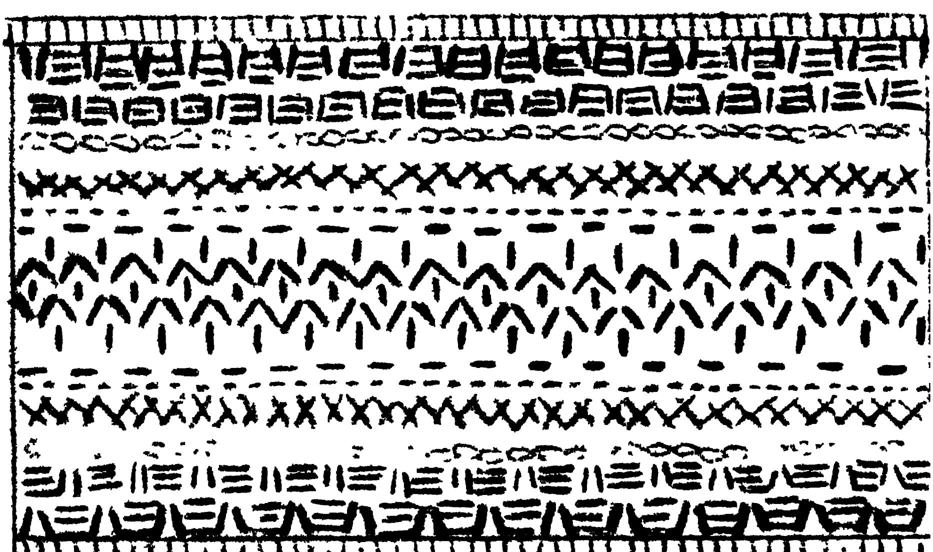
This is the most usual way of finishing an edge. The hem must be even and should be tacked down before the sewing is begun. The needle is inserted in a slanting direction up and under the hem. It comes out just above the edge of the hem and is inserted again a little in front of the place where it came out. The thread must not be pulled tightly or it will pucker the material.

Stitching (Fig. 3)

Stitching is the firmest method of joining two pieces of material. It consists in taking small stitches in a straight line, inserting the needle for each stitch at the point where it came out in the previous stitch. A thread of the material may be drawn out as a guide, to keep the work straight.

Over-sewing (Fig. 4)

This method is most often used when two selvedges have to be sewn together. Tack them firmly in place. Take small stitches through both pieces of material, inserting the needle at the back and bringing it out straight through to the front. Insert it again for the next



The border above is worked largely in tacking stitch, used horizontally, vertically and diagonally, but there are two lines of herring bone, two of chain stitch and four of outline stitch. Care and judgment must be exercised in the placing of the colours. Those that differ most from the background should form the smaller stitches.

PLAIN NEEDLEWORK (1)

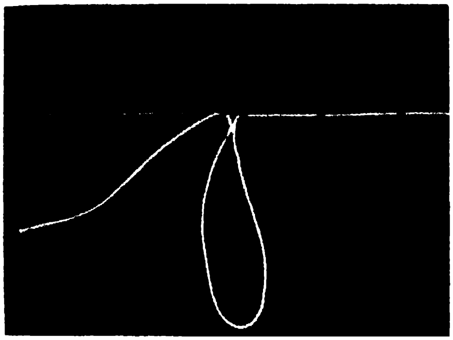


FIG. 1 **shows how to tack two pieces of material together. Only a small stitch must be taken through, or the two pieces will pull apart.**

FIG. 2.—In hemming, the direction of the needle is all-important. It must slant, as in the picture, and be inserted again in front

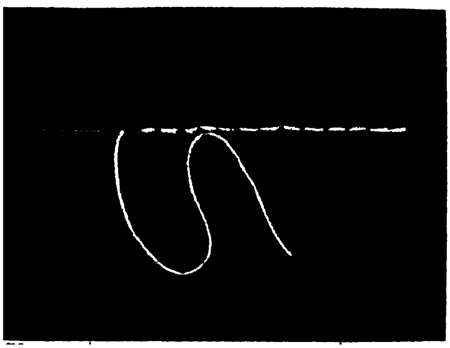


FIG. 3.—In stitching the needle is put in where the thread from the previous stitch came out. It is important to make all the stitches the same length.

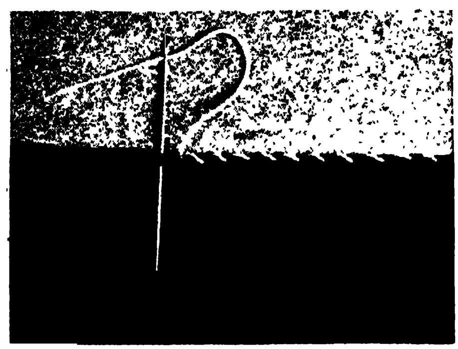


FIG. 4.—The direction of the needle is important in over-sewing. It should point straight towards the body as it comes through. Note how the stitches slant.

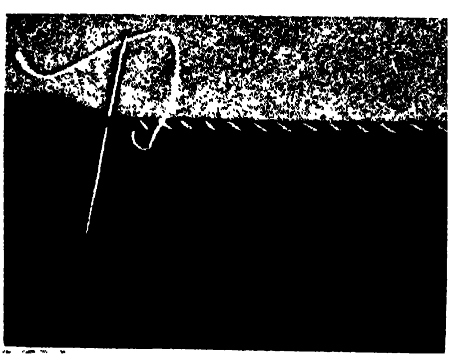


FIG. 5.—Whipping is the same stitch as over-sewing, but it is done over only one thickness of material, the edge of which is rolled over by the left thumb.

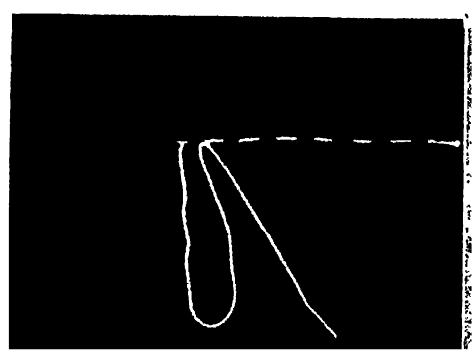


FIG. 6.—A knot is used to begin a gathering thread. The stitches must be of equal length, and of the same length as the space between.

PLAIN NEEDLEWORK (2)

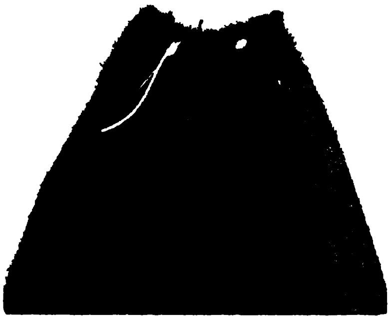


FIG 7 shows the gathers pulled up for stroking The eye end of the needle should be used for this for fear of tearing the material

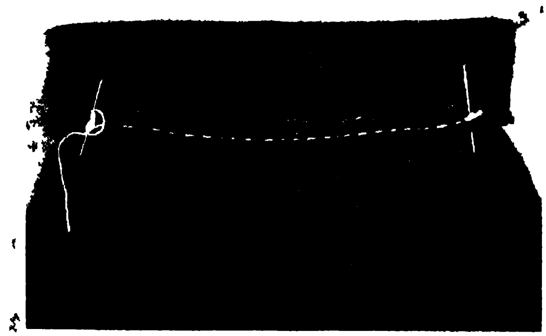


FIG 8 – Here the stroked gathers are ready to be set into the band They must be tacked into position and then stitched down to the band on the wrong side one stitch being taken over each pleat

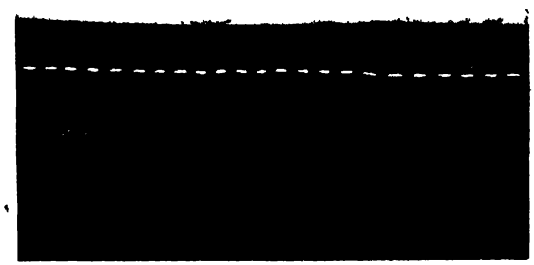


FIG 9 shows the first part of a run and fell seam The work must next be opened up flat and a small hem turned down on the back piece of material and tacked in position

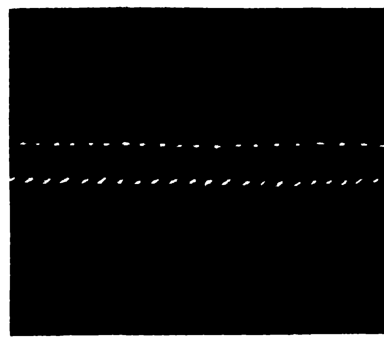


FIG 10 —Here the hem has been sewn down and the finished seam is seen It makes a flat join and is useful in making underclothing

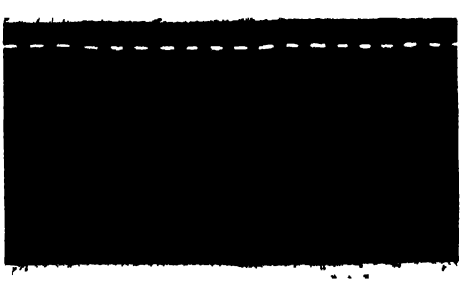


FIG 11 shows the first part of a French seam This is done on the right side of the material The raw edges are then trimmed as close to the seam as possible

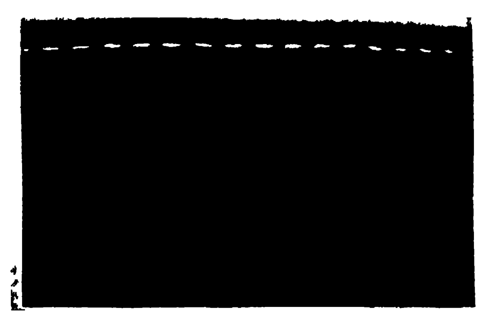


FIG 12 In this the finished French seam is seen This second part is done on the wrong side of the material The seam is used in dresses blouses and children's clothes.

stitch a little in front of the place where it came out in the previous stitch.

Whipping (Fig. 5)

The stitch in this case is the same as in over-sewing. It is used to finish an edge where a hem is not desired, and sometimes lace is sewn on at the same time. Roll a small portion of the raw edge of the material towards the body between the moistened finger and thumb of the left hand. Sew this down as in over-sewing, then roll the next part. Never roll more than 1 inch at a time, as it comes unrolled and is apt to fray with too much handling. If lace is to be joined by this method it should have its straight edge laid at the back of the material and the stitch taken through both lace and material.

Gathering (Figs. 6, 7, and 8)

This must be started with a knot which should be fairly large and should be on the right side of the material. Small even stitches are picked up, keeping the line parallel with the edge of the material (Fig. 6). When the end is reached, take off the needle and make a knot at the end of the thread. Put in a pin at right angles to the line of gathering thread, just beyond the last stitch, which should be ½ inch from the end of the material. Pull the gathering thread up tightly and wind the cotton round the pin, first round the head then round the point (Fig. 7).

To Stroke the Gathers. Hold the material with the gathered part over the first finger of the left hand. Take the needle in the other hand and pull it gently down between each fold of the material, using the eye end so as not to tear the material.

To Set the Gathers. When the gathers have all been stroked into position, take out the pin, attach the right-hand end to the band, ½ inch from the head of the band with a pin, attach the other end in the same way to the other end of the band, regulate the fullness and again wind the cotton round the pin. Tack the seam in position.

The gathering must now be stitched to the band, which is placed behind the gathers with the two right sides together and the raw edges at the top. Take one stitch through each fold.

Turn the ½-inch ends of the band to the inside, turning also a ½-inch hem on the wrong side of the band itself (Fig. 8). Tack this down over the gathering thread. Over-sew the ends, and hem the rest of the band, taking one stitch between each gather.

Run-and-Fell Seam (Figs. 9 and 10)

Tack two pieces of material so that the front piece is ½ inch lower than the back one (Fig. 9). The right side of the material is inside. Run all along the edge of this lower piece (running is the same stitch as gathering, but is not pulled up). When this is done, trim the lower piece as narrow as possible, open up the seam, and run a finger or thimble along the seam on the right side. Now fold over a very narrow hem on the back piece of material. Tack it and hem it down neatly. This is called felling (Fig. 10). It makes a neat flat seam.

French Seam (Figs. 11 and 12)

Put the pieces of material to be joined with their edges meeting. Tack them firmly. If a thick material is to be sewn this should be stitched a ¼ inch from the edge. If the material is thin a fine running stitch is better. This first seam should be done on the right side of the material (Fig. 11).

Now turn the garment inside out and make another seam, similar to the first, on the wrong side of the material (Fig. 12).

For flannel the first seam is stitched as for the first seam described above. Then the two raw edges are opened out and each is herring-boned down to the material (see Herring-bone).

Sewing on Buttons (Figs. 13 and 14)

Linen buttons may be sewn on in either of two ways. First by making a

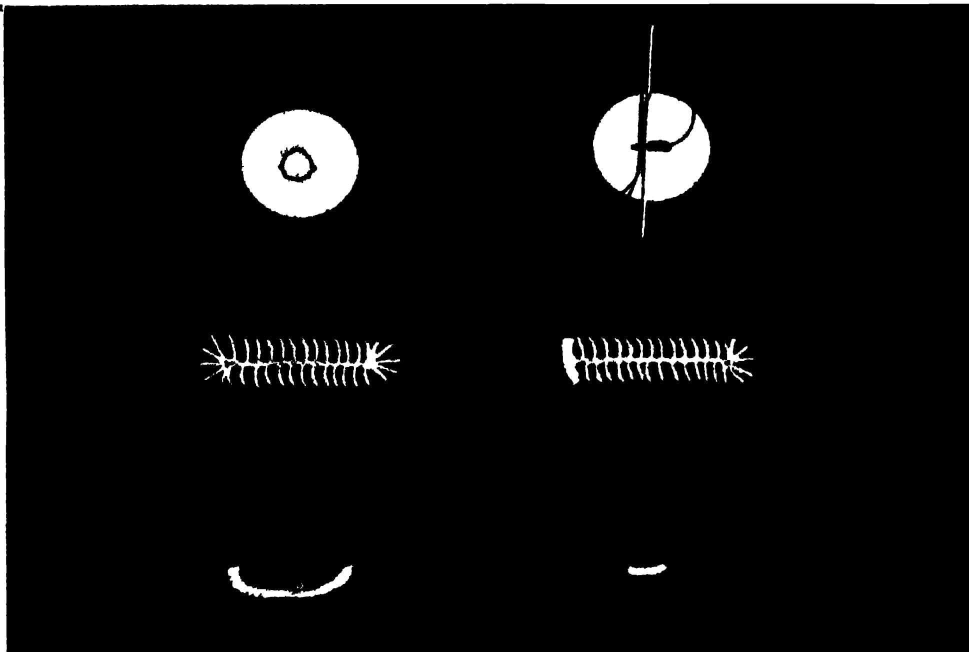


Fig. 13.—Linen button attached with a ring of stitching

Fig. 15 shows how to make an ordinary buttonhole

Fig. 17.—Large buttonholed loop to take a button

Fig. 14.—Linen button attached with a buttonholed loop

Fig. 16.—A buttonhole that will stand a strain

Fig. 18.—Small buttonholed loop to take a hook

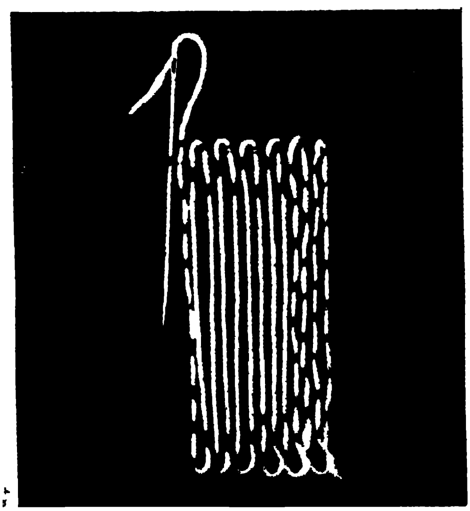


Fig. 19.—This shows how the right side of a darn should look before the cross threads are darned in. Note the loops which allow for shrinkage

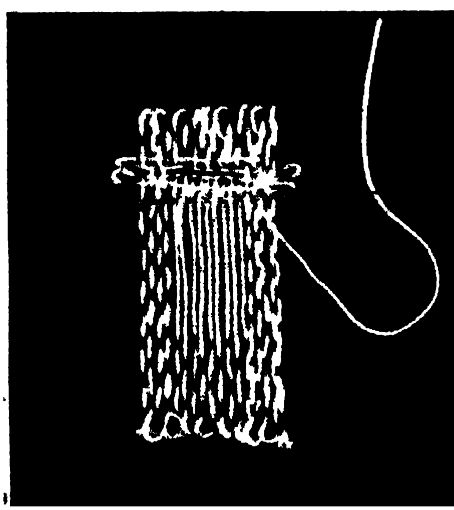


Fig. 20 shows the method of filling in the hole in darning. Thick wools or cottons should never be used for this work as they tear the material in working

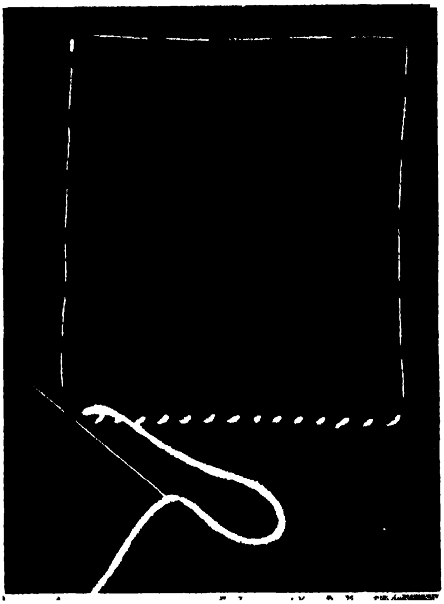


FIG. 21

A patch applied over the worn part This must be tacked firmly in position and hemmed down with small stitches

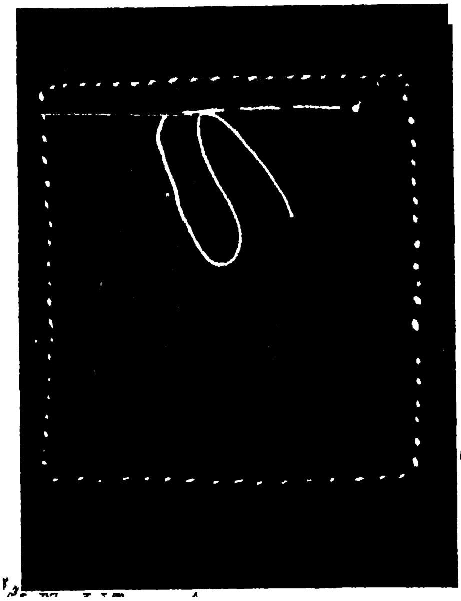


FIG. 22

Here is shown the worn part of the material cut away. The part that is left must be mitred, tacked and hemmed down

ring of stitching as in Fig. 13, or by taking three or four long stitches across the top and covering these with buttonhole stitch as in Fig. 14, using the eye of the needle.

Buttonholes (Figs. 15 and 16)

Button stitch is the same as blanket stitch with stitches close together. Buttonholes must be cut on the straight and should always lie across, not up and down a garment. They must be worked as soon as they are cut or the edges will fray.

Starting half-way along one side, work in buttonhole stitch, with the stitches as close together as possible until the end is reached. Five oversewing stitches should be taken at the end, the second side worked, five oversewing stitches taken at the other end and the first side completed (Fig. 15). The thread must be fastened off neatly at the back by running it under the backs of the stitches.

On a buttonhole where there is a great strain the end where the strain comes should be done as in Fig. 16 Instead of over-sewing this end several long stitches should be taken across and then these should be neatly covered with buttonholing

Loops (Figs. 17 and 18)

Where material is too thick to make a buttonhole a loop is often used. A pencil should be laid on the material and two or three stitches taken over this. Take the pencil out and test whether the stitches are the right length by passing the button through them. The button should go through easily, as the loop tightens when it is being covered. Cover these stitches with buttonhole stitch, being careful to see before starting that enough thread is in the needle to finish the work, as it is not possible to join it in the middle (Fig. 17).

A smaller loop for a hook is made without the pencil (Fig. 18).

Darning (Figs. 19 and 20)

Use fine wool or silk for darning, and work with the smallest-eyed needle that will take the thread. Use silk on silk and wool on wool. Work on the right side of the material.

Run two or three rows of darning stitch up and down the material by the side of the hole, leaving a small loop at the turning. Darning always shrinks in washing, and if these loops are left the darn will not pucker when it shrinks. When the hole is reached the thread to cover it must be on the right side of the material, and the needle should be inserted on the right side of the material on the other side of the hole (Fig. 19). Pick up two or three stitches on each side of the hole at top and bottom as well as at the sides. When the first threads are laid, cut off the wool or silk, and start darning from side to side, filling in the hole by going alternately over and under the laid threads as well as over and under the stitches at the sides of the hole. The thread is not fastened either at the beginning or end of the work (Fig. 20).

Patching (Figs. 21 and 22)

Take a piece of material to match the piece to be patched. Cut a square that will cover the hole and leave 1 inch to spare at all four sides. If the material is patterned, match the patterns on the patch. Turn in a ⅛-inch hem all round this square, tack it firmly and hem down on the right side (Fig. 21).

Turn over to the wrong side, cut away the worn material, slit up the corners to a depth of ½ inch, turn in a hem and sew it down (Fig. 22).

EMBROIDERY STITCHES

Blanket Stitch (see p. 395)

Chain Stitch (Fig. 1)

Hold the thread down with the left thumb. Take a stitch downwards from the place where the thread started. Pull the needle through. Take the next stitch from inside the previous one. This is suitable only for thick strands of silk, wool or cotton.

Couching (Fig. 2)

Place one or more thick threads in position and sew them down with one strand of a thinner thread, taking regularly spaced stitches. This looks best when the couching thread is in another colour from the threads which are to be sewn down.

Cross Stitch (see p. 390)

Daisy Stitch (Figs. 3 and 4)

Hold the thread down with the left thumb and take a stitch like a chain stitch (Fig. 3). Now insert the needle under the loop and bring out near the beginning of the previous stitch (Fig. 4). Use thick strands of silk, wool or cotton for this stitch.

Darning (Fig. 5)

This is used in embroidery to fill up backgrounds. It may be worked in silk, wool or cotton. Lift a very small stitch and keep the work regular.

Feathering (Fig. 6)

Hold the thread down with the left thumb. Pick up a slanting stitch to the left of the thread, with the needle pointing towards the body, pull the needle through. Hold the thread down and take the next stitch to the right of it, slanting towards the middle. This is generally worked in cotton thread, but can be done in silk.

Fly Stitch (Fig. 7)

Take a stitch as for feathering, but insert the needle in a line with the starting place of the thread. Catch the thread down with a small stitch as in daisy stitch taking the needle back to the right of the stitch just completed. This is suitable for thick threads only.

French Knots (Fig. 8)

Work this with double thread. Take

EMBROIDERY STITCHES (1)

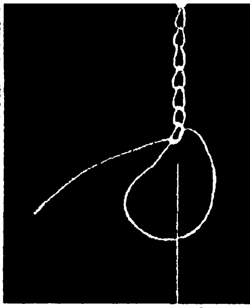


FIG. 1.—*Chain Stitch.* — The needle goes back each time into the last loop.

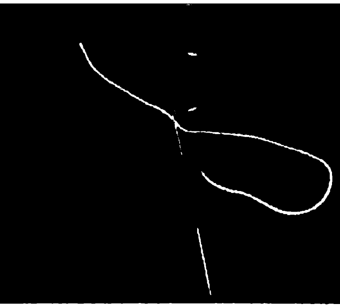


FIG. 2.—*Couching.*—One or more thick strands sewn down with a thinner strand.

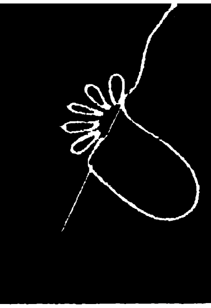


FIG. 3. — *Daisy Stitch.*—The first part resembles one chain stitch.

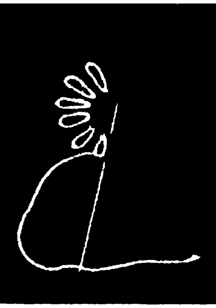


FIG. 4. — The needle taken back to the centre fo the next petal.

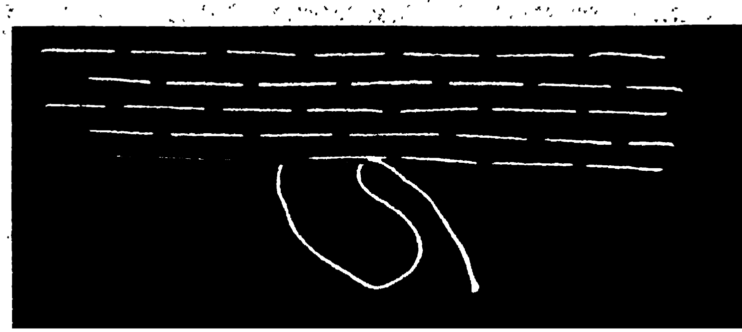


FIG. 5.—*Embroidery Darning.*—This consists of rows of tacking stitch, in which the stitches of one row alternate with the spaces in the previous row. It is used to fill in backgrounds.

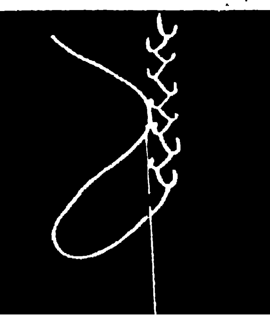


FIG. 6.—*Feathering.* Notice th slant of the needle. It must b inserted each time below th end of the previous stitch.

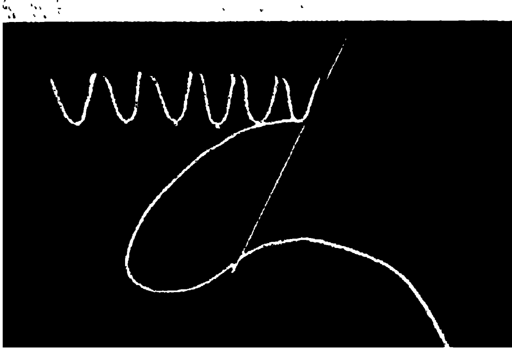


FIG. 7.—*Fly Stitch* is like daisy stitch with the top end open, and the stitches in a row instead of a circle. Two creases may be made in the material to keep the edges parallel.

FIG. 8.—*French Knots.*—These are ofte used to fasten down a hem. They ar also used as centres for flowers, for sma flowers, such as forget-me-nots, or to forr a fruit.

EMBROIDERY STITCHES (2)

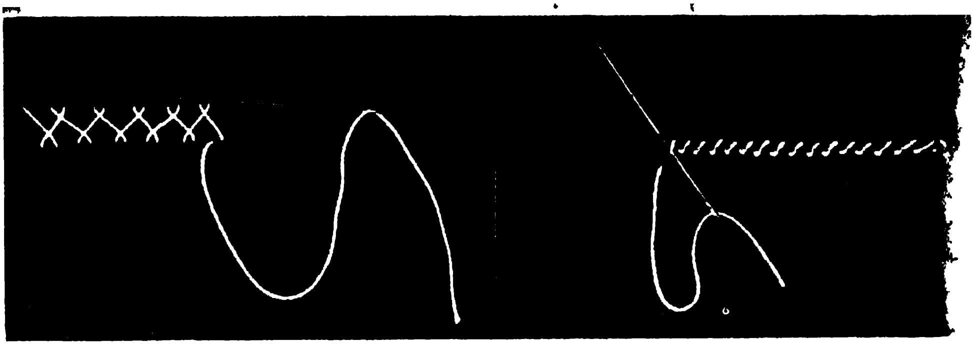


FIG 9 *Herring boning* —This is a useful stitch in embroidery It may be worked solid in colour on the wrong side of transparent white material to form a design

FIG 10 —*Hem stitching* —This is very effective if the other edge of the drawn threads is also worked, keeping the threads in the same bunches (see p 416).

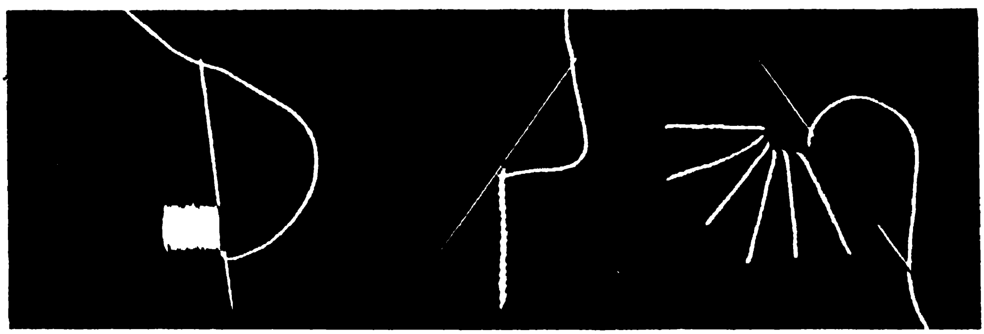


FIG 11 *Satin Stitch* —This is a useful stitch for solid embroidery in either natural or conventional design Padding underneath improves it

FIG 12 —*Stem Stitch* This is sometimes called outline stitch It is used for outline embroidery, and also for stems and veins

FIG 13 *Stroke Stitch* is very effective worked in thick wools or raffia on canvas It is especially good for geometrical designs

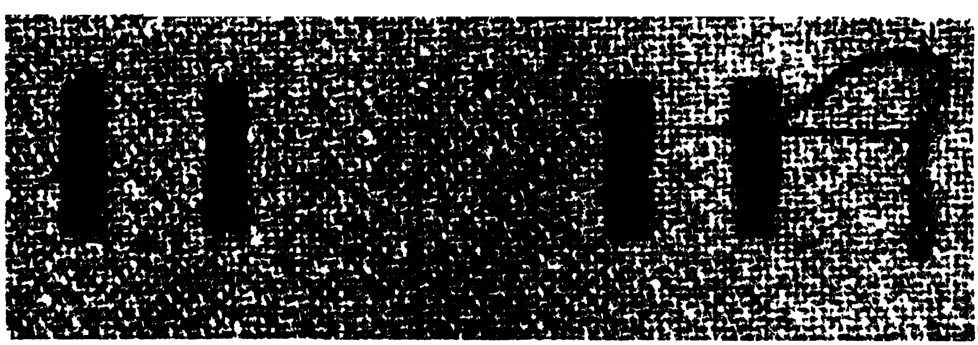


FIG 14 —*Weaving Stitch* -Laid threads are seen above Instead of laying these, threads may be pulled out of any coarse-meshed material as for hem-stitching.

FIG 15 shows the method of weaving the threads shown in Fig 14 The weaving may be done over any number of groups There are only two groups in the illustration

a very small stitch with the needle, twist the double thread once round the needle, and, holding the twist with the thumb, pull needle through and insert it under the knot. This looks best in silk and cotton threads.

Herring-bone (Fig. 9)

This is worked from left to right on two parallel lines. Bring the needle to the front on the top line, then, keeping the needle under the thread, take a small stitch on the lower line, then one on the top line. This stitch is generally used on flannel where a double folded hem is not desired. It should be worked in sewing silk. If a closed herring-bone stitch is worked, with no space between the stitches, a neat double row of stitches will result on the right side. It can also be used for decorative purposes in cotton or wool.

Hem-stitching (Fig. 10)

Below the hem pull out as many threads as desired. The number will vary according to the material used, more being pulled out in finely woven and fewer in a thick material.

Tack the hem down. Pass the needle under three, four or five threads, pull it through, then, bringing it back to the space it started from, take a hemming-stitch through the hem, bringing the needle out above the little cluster of threads thus pulled together. Silk thread should be used on a silk material and linen on linen.

Satin-stitch (Fig. 11)

This stitch is used to cover a space, the needle being inserted close to the previous stitch. It can be worked either from right to left or left to right. It is best worked in silk or cotton.

Stem Stitch (Fig. 12)

This should be worked in firm and fairly fine thread, as it is used for definite lines. Pick up a small stitch, always keeping the needle on the left of the thread and on the left of the previous stitch.

Stroke Stitch (Fig. 13)

This consists of single stitches taken in any direction the pattern may require. It is best worked in thick threads.

Weaving Stitch (Figs. 14 and 15)

Strands of thread may be worked for a foundation, as in Fig. 14, or threads may be drawn from the material. Divide the strands into equal numbers and darn them as in Fig. 15, using a tapestry needle.

Borders can be worked in this way in blocks of alternate colours, with drawn threads as a foundation, or darned strands may be used as slots for cord in drawing up bags. Thick silk, cotton or wool should be used for working.

Now that we have heard about all these different materials and what we can do with them, let us consider, what is rarely thought of, but much more important, the effect that the work has on the worker.

A piece of work may be well executed and beautiful, but unless it is the unaided expression of the worker (in choice of suitable material, choice of design and the method and means of working it out, as well as the work itself) it is of little value, as it has done nothing to strengthen the worker's individual powers.

And again, no matter how beautiful the result is, if the work is not the very best that the worker can produce it cannot be regarded as satisfactory. Remember the proverb, "The good is the enemy of the best," which means that a person who is content to do less than his best will be satisfied with second-best all his life, making no effort to improve. A child should not compare his work with that of other children, but with what he could previously do.

It is only if he trains his hands in this way to be the servants of his brain, and uses his intelligence, judgment, patience, perseverance and powers of observation in all his work that he will one day understand what is meant by "The joy of creation."